

CONSEIL PERMANENT INTERNATIONAL POUR
L'EXPLORATION DE LA MER
CHARLOTTENLUND SLOT — DANEMARK

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RAPPORTS
ET
PROCÈS-VERBAUX DES RÉUNIONS
VOLUME CXX

NORTH-WESTERN AREA COMMITTEE
REPORT OF THE SUB-COMMITTEE ON FAXA BAY

EDITED BY
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EN COMMISSION CHEZ
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COPENHAGUE

—
Mai 1948.

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A. REPORT

PREAMBLE

In considering a proposal to close Faxa Bay, or any other nursery area, the critical question is whether the sacrifice of present fishery interests within the area is likely to be made good by greater yield of fisheries outside the nursery area.

An opinion on this question may be based on slender information or on weighty information; and all the information available is included in the following report. In the opinion of the Sub-Committee the information available does not form a suitable basis for a recommendation for *permanent* closure of the Faxa Bay, because it does not provide definite answers to the following questions:

- (I) *To what extent is the fall in yield of halibut, plaice, and haddock fisheries in Icelandic waters due to fishing in Faxa Bay?*
- (II) *How much greater will the weight of fish emigrating from a closed Faxa Bay be than the weight of fish emigrating from the bay under fishing?*
- (III) *What subsequent contribution to the yield of the fisheries at Iceland is made by emigrants from Faxa Bay?*

The Sub-Committee considers that so long as these questions are unanswerable, no recommendation can be made for *permanent* closure of the bay.

It remains true, however, that, to many members of the Sub-Committee, the answers to the above questions appear self-evident: that to protect a well-known and scientifically proven nursery ground,

which undoubtedly includes an appreciably large proportion of the nursery area of halibut, plaice, and haddock (in Icelandic waters), *must* be profitable to the fisheries of these three species at Iceland as a whole.

It is also agreed, by all members of the Sub-Committee, that the obtaining of answers to these questions for Icelandic waters is of general importance.

The Sub-Committee, therefore, rejecting for the time being the idea of permanent closure, has turned its attention to the case for an *experimental closure for a limited number of years*. It is with the question of experimental closure, that the present report is concerned.

It is to be noted that such an experimental closure is proposed on the grounds that Faxa Bay is undoubtedly an important area as a nursery, and the arguments put forward in this report are based on that fact, and would not be applicable to proposals for closing areas for protection of spawning fish, still less for protection of a local fishery. In fact, Iceland would have to sacrifice a local fishery if the proposals of this report were adopted.

It is assumed throughout this report that such an international experiment would not be carried out without some form of fair compensation to the fisheries normally operating in Faxa Bay. It is also assumed that policing will be at maximum efficiency; otherwise the experiment would not be satisfactory.

INTRODUCTION

Progress of Work

It is perhaps not necessary to say that Faxa Bay has long been regarded as a very important nursery ground by the Icelanders. The Faxa Bay Question, viz., the question whether it would pay to protect the bay from trawling in order to conserve the fish stocks is at least as old as this century. Some few years after the last world war the question became of current interest. Then research work was planned by the late authorities JOHS. SCHMIDT and BJARNI SÆMUNDSSON, which resulted in the experimental trawling on two selected stations, one inside and the other outside the territorial boundary, carried out by Danish scientists in the subsequent years. (Paper 3, Table 6).

The question on the closure of the Bay first came to be raised officially by his Excellency SVEINN BJÖRNSSON at the International Conference on Mesh-Regulation and Size-Limits of Fish, held in London, March 1937, where a proposal from the Icelandic Delegation was submitted to the conference (Paper 2) accompanied by a statement by FRIDRIKSSON (Paper 1). The proposal was admitted and passed to the International Council for the Exploration of the Sea which treated the matter directly on their first sitting in Copenhagen July 5th 1937:

"The President drew attention to the proposal by the Icelandic Minister in respect of protective measures in the Faxa Bay, which had been copied from the report of the London Conference and circulated to the present sitting. The Conference having been unable to treat this proposal, had submitted it to the Council for further examination. The question would in the first instance be laid before the Consultative Committee and then before the North Western Area Committee."¹

After having been considered by the Consultative Committee the subject was handed over to the *North Western Area Committee*, which in their meeting on July 6th appointed a "*Sub-Committee on the Faxa Bay Question*".

¹ Rapp. et Proc.-Verb., Vol. No. 105, 1ère part. p. 11, Copenhagen 1937.

The following members were appointed:

Mr. DAVIS (England).

Mr. GRAHAM (England).

Dr. LE DANOIS (France).

Prof. HAGMEIER (Germany).

(failing him Dr. LUNDBECK).

Dr. TESCH (Holland).

Prof. HJORT (Norway).

Dr. CLARK (Scotland).

Dr. TÅNING (Denmark).

Mr. FRIDRIKSSON (Iceland).

The Sub-Committee met on July 6th and elected Dr. TÅNING as Chairman. The following proposals were adopted:

"It was proposed that a preliminary review of the Faxa Bay question should be prepared by Dr. TÅNING and given to the members later in the year and that the Committee should meet in the winter of 1937—38 to prepare a programme of research and for other business relating to the question.

It was proposed that

- A. Enquiries on fishing in Faxa Bay should be addressed through the International Council to the following countries: Belgium, Denmark, England, France, Germany, Holland, Iceland, Portugal, Scotland, and Spain. The enquiry should be directed to the acquisition of information (whether published or not) as to fishing carried out by the respective countries, the composition of the catch, the total quantities obtained, and if possible, the size composition of several species. Furthermore enquiry should be made whether the statistics could be improved for this area.
- B. Research work to be carried out as to present composition of the stocks of the principal food fishes (Plaice, Haddock, Halibut, Lemon Sole and Cod). It was recommended that Iceland should commence this work during October 1937 and February 1938.

- C. Information should be collected by Danish and Icelandic patrol vessels as to the number of trawlers of different nationalities working in the regions defined by the Committee within the area.
- D. A preliminary survey of the data concerning the principal food fishes collected during the period 1924—1937 should be carried out immediately, with a view to directing the lines of future research work.
- E. A preliminary survey of the Bay, the life histories of the principal food fishes, the different fisheries in the Bay, and the relative importance of the Bay as a nursery area for the various species should be issued for the benefit of the members of the Committee.”¹

The first step taken by the Chairman was (a) to engage several specialists in different countries to write a series of papers about the subject, the bay itself, the fisheries carried out there and the animal life in the bay, in order to check what supplementary research work might be necessary. Thus he succeeded in collecting a series of dissertations, which were issued in a volume and submitted to the members of the Sub-Committee as: “*Faxa Bay. Physical Characteristics, Fish Fauna and Fisheries, A Preliminary Report*”. Several of the Papers issued here (No. 4—9, 11—14 and 25) are derived from this basic publication. (b) To submit to all countries engaged in fishing in the European Atlantic, the questionnaire reproduced in paper No. 19 (Enquiry on the Fishery in the Faxa Bay, Iceland).

On the basis of the replies to the enquiries and the papers already mentioned the Sub-Committee continued their work which was curtailed by the war 1939—45.

It is not necessary to go into details, but a few remarks must be added about the progress of work.

A glance at Paper 3 will give a good survey of the field work, which has been carried out throughout the years. Table 6 shows that experimental trawling has been carried out continuously throughout 17 years from 1924—1940 (incl.), besides many other kinds of scientific activities, which have been maintained in the same period. — During the war-years operations in the bay had to be postponed until 1945 when we succeeded in taking up routine work again by means of small chartered motor trawlers. — The rather extensive table work in Tables 7, a-c, might at a glance look somewhat confusing, but the Sub-Committee has found it advisable to publish it in full for the benefit of future workers, who might be concerned with research work in Faxa Bay during a possible period of closure. According to Table 8 (Paper 3) experimental trawling in Faxa Bay now covers every month of the year except January, although the most active operations have taken place during the period May—August.

¹ Loc. cit. p. 23.

The Faxa Bay Sub-Committee has held the following meetings:

1. The first meeting in Copenhagen June 1937 has already been mentioned.
2. The full Committee met for a second time in connection with the annual meeting of the Council in Copenhagen May 27th 1938. The following points for future work were adopted:
 - A. Continued trawlings on the fixed stations in the southern part of the Bay.
 - B. Quarterly trawlings for the study of the movements of the plaice on those stations.
 - C. Trawlings in other localities of the Bay.
 - D. A general bottom sampling research of the Bay.
 - E. Comparison of Breida and Faxa Bays, i. a., with regard to the stock of young halibut.
 - F. Marking experiments to be continued: (a) plaice on fixed stations and in other localities; (b) halibut, vitality experiments.
 - G. The compilation of data on the comparison of commercial catches and records of fishing vessels to be continued by Mr. FRIDRIKSSON.¹

The following recommendations were further adopted.

- A. The Sub-Committee recommended that Mr. ARNI FRIDRIKSSON be asked to act as secretary of the Sub-Committee on the Faxa Bay Question and be allowed expenses to work in Copenhagen from time to time as might be necessary.
- B. The recommendation made last year for a meeting to be held during the winter of 1937—38 in order to prepare the programme for future work was carried over to next year.
- C. The Sub-Committee recommended that provision be made for four members of the Sub-Committee and the Chairman to join the Icelandic member in visiting Faxa Bay during the financial year 1938—1939.²

3. At the end of October 1938 the Chairman, the Secretary and Prof. HJORT met in Copenhagen in order to prepare different papers and discuss several questions before the meeting provided for in recommendation B above.

4. This meeting took place March 17th—20th 1939, and was attended by the Chairman, the Secretary, Mr. GRAHAM and, partly, by Professor HJORT and the Administrative Secretary. The meeting passed through the material which had been distributed and prepared a Progress Report which was, later on, submitted to the members of the Sub-Committee. All essential parts of this Progress Report are now included in the present report.³

¹ Rapp. et Proc.-Verb., Vol. No. 107, I, p. 30, Copenhagen, 1938.

² At a meeting of the Consultative Committee it was decided that this meeting should be postponed until 1939—40.

³ For details of this meeting see: Rapp. et Proc.-Verb., Vol. No. 109, I, p. 20—21, Copenhagen 1939.

5. The next full meeting took place in Berlin, on May 15th, 1939. It was then reported that Dr. KOTTHAUS would replace Dr. LUNDBECK in the Sub-Committee failing Professor HAGMEIER and that Belgium wished to be represented by a member to be appointed later. It was agreed that work in progress should be continued and completed before next year's Council Meeting. Further, Mr. GRAHAM, Dr. TÅNING and Mr. FRIDRIKSSON were asked to prepare for issue, by correspondence, the papers circulated so that the report could be available as printed MS at next year's meeting. Finally the meeting decided that the Chairman and four other members of the Sub-Committee should join the Icelandic member in visiting Faxa Bay during the summer 1939.¹

6. The meeting in Reykjavik took place on July 23rd—27th, 1939 and was attended by Dr. TÅNING, Prof. HJORT, Prof. HAGMEIER, Mr. DAVIS, Mr. FRIDRIKSSON and Mr. F. DEVOLD (Norway), who was a guest. Details of this very important meeting will be referred to later in this report. It was agreed that the Sub-Committee should meet in Göteborg in May 1940 two days before the Council Meeting in order to work out a final report on the question and make recommendations to the International Council.

7. During the war the members were out of contact for six years and the Sub-Committee could not be convened until October 16th 1945 in Copenhagen.² It was admitted that Mr. DEVOLD should replace Prof. HJORT; Dr. HAVINGA, Dr. TESCH; Dr. LE GALL, Dr. LE DANOIS and, that Belgium should be invited to appoint a member if desired (this was cancelled December 1945 at the request of the Belgian delegate). Further the Sub-Committee appointed three editorial members (Dr. TÅNING, Mr. GRAHAM and Mr. FRIDRIKSSON), who should meet during the winter and prepare for issue the final report on the Faxa Bay Question as manuscript in proof. Then the full Sub-Committee should meet one or two days before the next Council Meeting in Stockholm in order to prepare a recommendation on the question to the Council.

8. The editorial members met October 20th 1945 and April 2nd 1946 in Copenhagen and London respectively, and in Lowestoft 27th to 29th of May 1946. During these meetings the present final report was prepared and all the papers dealing with the subject were arranged and revised.

There have been written a number of papers on behalf of the Faxa Bay Sub-Committee, most of which are accompanying this report as appendices, some of them slightly abridged.

¹ Rapp. et Proc.-Verb. Vol. No. 109, p. 35—36, Copenhagen 1939.

² In the meanwhile a proposal on the matter was submitted to the International Fisheries Conference held in London 1943 by the Icelandic Delegation.

Research ships from Denmark, England, Holland, Iceland and Scotland have contributed to the work carried out.

I. Description of Faxa Bay

A glance at Fig. 3, Paper 4, gives an idea of the geographical position, the size and the configuration of Faxa Bay. The western boundary of the bay proper is a straight line from Gardskagi in the south to Malarrif in the north. The Sub-Committee has found it convenient to subdivide the bay into three areas as shown on the chart. The total size of the bay east of the boundary named above is about 1,300 nautical square miles: (nearly the same as Cardigan Bay in Wales)

490 n.sq.m. in the territory
810 " outside it.

The sizes of the three areas, outside territorial limits, are (from south to north)

- 1) 160 nautical square miles
- 2) 500 " " "
- 3) 150 " " "

As will be seen from the chart the major part of the bay is rather shallow, as only about 160 n.sq.m. are beyond the 100 m. depth-curve, approximately 500 n.sq.m. between 50 and 100 m. deep, the remainder, or nearly half of the bay, territorial waters included, being less than 50 m. deep (see Paper 4).

As shown in Paper 5 the water masses in Faxa Bay belong mainly to the so-called coastal category, the salinity being between 34—35 ‰ at the surface, slightly higher at the bottom; but "Atlantic water with salinity greater than 35 ‰ may penetrate into the Bay, right to the 25 m. line, especially in the summer months" (Paper 5). On the other hand, sporadic appearance of arctic and boreo-arctic species might indicate that the cold water from the Denmark Strait would penetrate into the Jökuldjúp at least now and then during the winter months. The lowest surface temperature prevails in January whereas a maximum is reached in July—August, as will be seen from Fig. 6, Paper 5. The temperature in the deeper layers, as for instance at the 50 m. depth-line (Paper 5, Table 11) is apparently more homogeneous throughout the year and not reaching the annual maximum until in September. Information about tides, oxygen, density etc. is given by THOMSEN 1938¹.

As will be seen from Fig. 5, Paper 4, more than half of the bay has the bottom covered with coarse sand, shell, gravel or rock. In the deepest (Jökuldjúp), and most sheltered (Hvalfjörður, Gardsjór)

¹ H. THOMSEN: Hydrography of Icelandic Waters. Zoology of Iceland I, 4, Copenhagen 1938.

parts on the other hand the superficial layers of the bottom consist of clay. Three other bottom-formations are also widely extended, viz., sand, clay mixed with sand, and gravel.

Taking the heterogeneous nature of the bottom into consideration it is not surprising that we find a great diversity of animal bottom life in the bay. Rather thorough investigations on the bottom fauna have been carried out throughout the years, especially in the southern part of the bay, which is by far most important from this point of view. A short description of the results is given in Paper 6 but for further information we can refer to works by SPÄRCK¹ and EINARSSON². As will be shown later, Faxa Bay is an outstanding nursery ground for fish, and the reason for this particular value of the bay is doubtless largely due to the abundance of two animal communities that live on the sea bed, communities characterized by two small bivalve shellfish, *Macoma calcaria* and *Spisula elliptica*. The *Macoma calcaria* community is found especially in the southern part of the bay and the *Spisula elliptica* community in the more open parts, where these animals are to be found in numbers comparable with or even exceeding those of *Spisula subtruncata* in the North Sea. The extent of the various communities of bottom animals found in the bay is shown on Fig. 7, Paper 6. Further Fig. 8, Paper 6 gives an idea of the qualitative and quantitative composition of the various communities. Besides the above-named bottom animals which are of paramount value as food for halibut, plaice, haddock etc., there is a number of other species, such as *Mytilus edulis*, *Cyprina islandica*, *Crangon*, *Eupagurus*, *Hyas*, *Nephthys* etc., which give rise to the richness of fish found here.

In paper 7 SÆMUNDSSON gives a survey of the fish fauna in the Faxa Bay. Of the ca. 140 species of fish known at present from Icelandic waters about half have been recorded from Faxa Bay (64) or just outside its boundary (10). Of the 64 species recorded in the bay proper 14 are rare summer visitors. The majority of the remainder belongs to the boreal group, and some few originate from the boreo-arctic or the arctic region. SÆMUNDSSON records not less than 29 species as being of more or less direct importance for human consumption, many of which are particularly valuable.—Although not of importance as food-fishes, three species, found in great number in the bay are of paramount value as food for the marketable species. They are: The lesser sandeel, which is found in huge numbers, the capelin and the Norway pout, the last-named mainly restricted to the deeper parts of the bay.

¹ R. SPÄRCK: The Benthonic Animal Communities of the Coastal Waters. The Zoology of Iceland. I, 6, 1937.

² H. EINARSSON: Survey of the Benthonic Animal Communities of Faxa Bay. Medd. fra Komm. for Danmarks Fiskeri og Havunders. Fiskeri, XI, 1, 1941.

II. The Life History of the most important Food Fishes in Faxa Bay

Five papers accompanying this report have been devoted to the five most important species of fish found in the bay: halibut, plaice, lemon sole, haddock and cod.

1. In Paper 8 JESPERSEN gives an outline of the biology of the **halibut** in Icelandic waters, especially in Faxa Bay. It is evident that the bay is of no value as spawning area for this species, nor does it seem to be much frequented by adolescent or adult fish. On the other hand it seems to play an immense role as nursery for young halibut as emphasized by JESPERSEN. That will be considered later.

2. As regards the **plaice** TÄNING has shown (Paper 9) that Faxa Bay is primarily of importance as a nursery ground. Yet spawning takes place, at least to some extent, in the more open parts towards the entrance, but the huge number of young plaice found especially in the southern part of the bay, originates from spawning grounds outside the bay. Two kinds of migration can be noted: (a) a movement of the young fish, as time passes, from coastal waters to the more open parts of the bay, where they seem to remain until maturity is reached, and (b) seasonal migration towards deeper waters in the cold period and back again into shallow waters in the warmer time of year. Maturity will be reached at an age of 6—7 years and at a size of approximately 35—40 cm. Then the greatest part of the stock may be supposed, according to marking experiments, to leave the bay for a southward or even a west- or northbound migration to spawning grounds. The growth-rate of the plaice in Faxa Bay is found to be rather slower inside the territorial limit than outside it, and somewhat slower in Faxa Bay as a whole than off the western part of the south coast where the fastest growth in Icelandic waters is recorded.

3. The biology of the **lemon sole** in Faxa Bay as elsewhere in Icelandic waters is far less known than in the case of the plaice. This fish is, however, found in the bay as a summer immigrant, in all parts of the bay with exception perhaps of the north-east corner, but it is more abundant in the southern section than anywhere else (RAE, Paper 10). It is more numerous inside than outside the territorial boundary and the growth-rate is slower on the territory than outside it. But "on the whole the rate of growth in Faxa Bay may be regarded as good by standards of lemon sole growth elsewhere" (RAE). As the distribution of lemon sole is limited to rather shallow waters it is beyond doubt that Faxa Bay is of great importance as a nursery ground for the Iceland stock of the species.

We know that the spawning is limited to the warm-water area, but we do not know for certain the relative value of Faxa Bay in this respect. According to RAE (Paper 10) the species reaches maturity in Faxa Bay when about 8 years old, but a considerable part of the catches, even over 40 %, may, at least in some years, be made up of fish of 9 years or older.

4. RAITT (Paper 11) takes account of the general features in the biology of the Icelandic **haddock**. According to SCHMIDT, this first seems to spawn mainly within the 200-meter depth-line in the warm-water area, and then seeks feeding grounds in the shallower waters of the S. and SW. coast, where the young fish are also found. So, RAITT comes to the conclusion that the Faxa Bay may, by its location and depth, in its outer reaches be regarded "as a normal spawning ground of Icelandic haddock and in general as a normal habitat of the immature year-classes which form the major proportion of commercial catches". The bay should thus be of great importance to the stock in all stages of its life. In the next section of this report we will however deal with its special value as nursery ground for haddock.

5. It is known from the fisheries (the cod-net fisheries in particular) and proved by SCHMIDT¹ that **cod** does spawn in Faxa Bay, at least to some extent, although the principal spawning grounds are situated in more open waters, especially off the south coast (Paper 12). After having spawned the cod shoals migrate to the colder waters off the W., N. and E. coast or westward to the Denmark Strait or to W. Greenland in search for food. On the food migration it enters the outer parts of the bay, especially the Jökuldjúp, as a rule searching for the dense shoals of capelin which are often to be found there at this time of the year. When returning to the spawning grounds in December and January the cod pays another visit to the bay, this time for the lesser sandeel which in most years is present in enormous density on the sandy bottom of the southern section. It is a well known fact that the principal nursery for the Icelandic cod stock is the cold water area in the north and east, and, in some years or periods of years, partly in Greenland waters. Nevertheless nursery grounds of some importance are found at other parts of the coast, also in Faxa Bay, as is shown in Paper 12. In spite of this the principal value of the bay for the cod stock is due to its great supply of food to migrating cod, as the main spawning and nursery areas are situated in other regions.

¹ JOHS. SCHMIDT: The Distribution of the Pelagic Fry and the spawning Regions of the Gadoids in the North Atlantic from Iceland to Spain. Rapp. et Proc.-Verb., Vol. No. 10, Copenhagen, 1909.

III. The relative Importance of the Bay as a Nursery

We can already conclude from what has been said above that the greatest value of the Faxa Bay is due to its significance as a nursery for some of the most valuable food fishes in Icelandic waters. This applies in particular to haddock, plaice and halibut, which we will now consider, leaving lemon sole and cod out of question, as the position of the lemon sole is not quite clear and as the future of the cod stock is by no means specially insured by the insignificant proportion growing up in the bay. Yet, it must be noted, that in the case of the lemon sole, the Faxa Bay area contains a higher proportion of younger fish than any of the other areas in Icelandic waters.

1. With regard to the **haddock** we have sufficient evidence to state the very high importance of the bay, especially the southern section, as a nursery. We know that the haddock in Icelandic waters will not in general reach maturity until 5 years old and at a size of at least 50—60 cm. The "Dana" trawlings at the two fixed stations have yielded material to show very clearly the relative abundance of young haddock in the bay during the years 1924—1934. This is demonstrated by STRUBBERG in Paper 20 (Figs. 31—33), where we see the size-composition of the catches during the summer months. It is evident that the main bulk of the stock consists in many cases of 1- and 2-year-old fish, especially on the territory where the density is much greater than outside it. We also have records from the years just before the war. Thus we found the density (on the territorial station) to be more than 600 on an average per trawling hour in May 1938. About 60 % were less than 23 cm., 61.9 % being only one year old, 36.2 % three years old and not more than 1.1 % exceeding three years age. Although the major part of the haddock may move to deeper waters during winter, considerable numbers of immature fish will be found in the shallow-water area throughout the year. This may be seen from the following table, which refers to trawl-catches made inside the limit by SS "Thor" in the period December to February 1938—1939.

Length cm.	%	Age-Group.	%
45+	0.2		
40-44	0.9	III+	1.1
35-39	4.6		
30-34	5.7		
25-29	38.2	II	48.5
20-24	5.5		
15-19	29.6	I	50.4
10-14	15.3		
Total	100.0		100.0

2. For the **plaice** the bay is one of the most important nursery grounds in Icelandic waters, the

fishing, however, reducing the number of small fish outside the limit rapidly. Thus, during the experiments 1924—1934 the number per 10 hours trawling (50' otter-trawl) inside the 3 miles limit has been some 730 specimens as against about 100 outside the boundary.

As already mentioned, the plaice will, when reaching maturity leave the bay for spawning, the age then being 6—7 years and the size about 35—40 cm. in accordance with the rather slow growth in these waters. Below is given the percentage age-group composition of the stock of immature fish (the VI-group being mostly immature, the VII-group mature fish), the samples originating from the fixed trawling stations in the southern part of the bay (depth 30—40 metres, summer hauls). As a result of the increased seine-netting in this part of the bay in later years, the percentage of specimens below 23 cm. has increased from not over 5 % to 20—40 % and even more (this may be seen in Fig. 29, Paper 20). The review is divided into three periods, 1924—27, 1931—34 and 1937—38.

Range of Percentages of various Age-Groups

	1924-27	1931-34	1937-38
	<i>Territorial</i>		
Age-Groups II-VI	64-93	85-99	99
VII-Group and older fish:	7-36	1-15	< 1
	<i>Extra-territorial</i>		
Age-Groups II-VI	66-84	93-99	97-99
VII-Group and older fish:	16-34	1-7	1-3

The age of the predominating year-classes has also shown a tendency to decrease. Dominating were:

in 1924—1927	IV—VII-group
1931—1934	III—V "
1938—1939	III—IV "

There is still one point of evidence that confirms the predominance of immature plaice in the bay, namely the English statistics, which show that the percentage of the category "small" is high. In the period 1932—1936 the composition of the English catches were:

5.2 %	Large
35.8 %	Medium
59.0 %	Small

3. Finally, in the case of the **halibut**, the Faxe Bay is especially important as a nursery ground, the year-groups I—III being predominant and very abundant in comparison with other grounds outside the bay. The predominance

of these groups is shown by trawling experiments of 1924—1935, which give the following percentage (by numbers) of the various age-groups inside and outside the territorial limits in the bay:

Age-Groups	Territorial	Extra-territorial
I	10.3	11.3
II	47.2	52.7
III	35.7	30.9
IV +	6.8	5.1
	100.0 %	100.0 %

Confirming this, the English statistics show that especially the category "small" is taken in the bay, about 80 % by weight, e.g., in 1932—1936 when the catches were composed thus:

9.7 %	Large
9.4 %	Medium
80.9 %	Small (see JESPERSEN, Paper 8)

This is of the order of 1 Million fish (retained; very high proportions of undersized halibut are moreover caught and accordingly wasted).

Just one additional example can be given in order to show the number of young halibut in the southern section of Faxe Bay. At the end of March 1939, 239 halibut were caught on the territorial station in 10 trawling hours. The composition of the catch was thus,

Age:	No. %	Size cm.	Av. Weight gr.
I	7.1	11—16	20
II	91.3	19—36	130
III	1.4	40—46	900
IV	0.2	48	1 500

It is clear from all the foregoing evidence that a very large destruction takes place in this nursery. A great many very small halibut are taken while they are still relatively of little commercial value.

IV. The Fishery in Faxe Bay

An outline of the historic development is given by SÆMUNDSSON in Paper 13. Roughly speaking we can, from a technical point of view, divide historic time into three periods of very different length. (a) The open-boat period covers the long run of time from the settlement until about the end of the 18th century, succeeded by the (b) sail-vessel period which coincides roughly with the 19th century. (c) In 1892 English trawlers first appeared in Icelandic waters and less than a decade later the Icelanders had commenced fishing by steam-trawlers and motor-boats. The central field for these new activities was primarily the main ports at Faxe Bay, preferably Reykjavik, especially as far as trawling was concerned.

It is of great importance to consider the present fishing activities in Faxe Bay and the relative value of the bay for the different

nations and the various fishing gears used nowadays.

The principal methods now applied in fishing in Faxa Bay are shortly described in Paper 14. Not considering the whaling from floating stations nor the pelagic drift-net fishing for herring we have to deal with three principal bottom-fishing gears used in the bay: The commercial otter-trawl, with or without the Vigneron-Dahl amendment, the Danish seine and the long-line. Of far less importance are stand-nets for cod and lump-sucker, handlines for codfishing and ring-nets for capture of young coalfish regularly used every year.

With regard to the relative importance of Faxa Bay as a fishing ground within the Icelandic area and the international interest in the fishing in the bay, we have various sources of information. One source has been observations from log-books of patrol vessels. That material is treated in Paper 15. A glance at Table 33 in that paper gives a survey of the relative importance of the bay for the different kinds of gears used here. 7.1 % of all trawlers operating in Icelandic waters have been found there especially during the late spring and the autumn. The bay is still more important for the seine-netting (12.9 %) although it is of largest relative value for the long-line fishing (26.9 %). This state of things has however showed trends to alter during recent years, the use of the long-line having decreased in favour of the trawl (Paper 15, appendix). As will be shown later, England and Iceland are the countries most concerned with the fishing in Faxa Bay. The relative value of the bay for these two nations may, to some extent, be judged from the following figures:

Landings from Faxa Bay, 1935, in % of total landings of the several species from Icelandic Grounds.		
English Landings % by Weight	Icelandic Landings (Estimated) % by Weight	
Plaice.....	10.7	25
Cod.....	7.2	10
Lemon Sole..	6.6	25
Halibut...	6.2	25
Haddock...	5.0	8

The explanation of the differences between the English and Icelandic figures comes from catches by seine. The relative value of Faxa Bay for the Icelandic seine-netting alone can be estimated from the following numbers, which give the percentage share from the bay in the total yield by seine-netting in all Icelandic waters in the year 1938.

	% by Weight.
Plaice.....	33.6
Cod.....	76.4
Lemon Sole.....	30.8
Halibut.....	43.6
Haddock.....	74.1

Turning now to consider the international interests in the bay we can refer to Paper 15, Tables 40, 41 and 42 and the appendix. In the early days of this century British trawlers were largely predominant, amounting to 95.8 % of all trawlers observed in the bay, in 1904—1906 (Table 42). During the following years the Icelandic trawler fleet developed rapidly and the Danish seine was taken into use some years later. In the years 1929—1937 Great Britain and Iceland together were responsible for about 90 % of the trawling in Faxa Bay, and Iceland alone was responsible for practically all the seine-netting (for details see Tables 40 and 41).

Another source of information on the international fishing activities in Faxa Bay are the replies from the different countries to the enquiries mentioned on page 6 in this report. A thorough treatment of this material has been made by TÁNING in Paper 19. According to the replies the countries enquired can be divided into three categories: (a) those not concerned with fishing with trawl and seine fishing in the bay, (b) those with some interest in these kinds of fishing and (c) those with great interest:

Not concerned:	Some interest:	Great interest:
Finland	Belgium	England
Ireland	Denmark	Iceland
Latvia	Faroes	
Norway	France	
Poland	Germany	
Portugal	Holland	
Spain	Scotland	
	Sweden	

As is pointed out in Paper 19, the bay is of far the greatest importance to the English and Icelandic fisheries, partly due to the great catches of haddock, plaice, halibut and lemon sole, taken through their activities.

With regard to the Icelandic fishing in Faxa Bay it is regretted that it is not possible to give more details than are given in Papers 14, 15, 16, 19 and 20, as the bay has not, as yet, been treated as a separate area in the Icelandic statistics.

Before we leave the fisheries in Faxa Bay, and go to deal with the effect of them upon the stocks of fish, some few remarks must be devoted to the changes of the Icelandic territorial waters in history, the now existing regulations, and the measures taken by Icelandic legislative power to protect the fish stocks by decree and law. In Paper 24 Dr. EINAR ARNÓRSSON, Judge of Supreme Court, gives an outline of the history of the Iceland territory from the earliest days up to present time. For more than 4 centuries or from the time of settlement until the end of the 14th century Iceland seems to have had unquestioned sovereignty over all waters around the island, and over all fisheries there. During the 15th century foreign fishermen began to visit Icelandic fishing grounds, and in 1621 the

Englishmen were formally permitted to fish at Iceland by a treaty between Denmark and England. According to this treaty fishing was prohibited on a territory about 16 n.m. wide (4 Danish miles). A decree issued 1872 seems to indicate that 4 n.m. territory was adopted by the Danish government, but the present 3 miles limit was first agreed upon by the Danish-English treaty from 1901, which is described by His Excellency SVEINN BJÖRNSSON in Paper 25.

During recent years Iceland has co-operated internationally in order to protect fish stocks by means of mesh regulations and size limits for fish (Paper 26).

V. The Influence of the Fisheries on the Stocks of Important Species of Fishes, especially in Faxa Bay

In Paper 20 STRUBBERG has given a very clear description of the density of fish on the two selected stations outside and inside the territorial limit in Faxa Bay. It must be pointed out, that these stations have been selected with regard to all conditions being as similar as possible, e.g., depth, richness of bottom fauna, salinity, temperature etc. The most significant difference is that one of the stations is situated on the territory whereas the other is located outside, on a ground much frequented by trawlers. It is therefore very interesting to compare the density of fish on both stations as is done in the above-mentioned paper. But we have also other sources by means of which we can study the influence of fishing activities upon fish stocks in Icelandic waters. Such a source is the total annual yield of a fish stock and the yield per unit of effort as an annual average. As will be seen from Fig. 21, Paper 17, since 1925 there has been a great increase in the amount of fishing by English trawlers in the Iceland area. The number of hours' fishing in 1937 was almost double what it was in 1925. The decline in the yield of fisheries for haddock, plaice and halibut in Icelandic waters is well known, whereas the cod seems to have increased in number after 1929. This highly migratory species seems to have benefited from the large-scale hydrographical changes, which have resulted in warming up of the arctic waters during recent years. We do not know how the Icelandic stock of cod would have reacted to the largely increased fishing efforts of the later years if conditions in the northern seas had remained as they were before 1925. The other three, less migratory species, plaice, haddock (both stationary in Icelandic waters) and halibut will now be considered.

1. Haddock. The higher number of haddock (number per trawling hour) on the territory than outside already indicates the influence of the fisheries. Thus haddock was 10—14 times more numerous inside than outside in the years 1924—1927

(Paper 20). After 1930 this difference has, however, been wiped out, partially at least, the relation being 1:1, 2:1, 2:1 and 6:1 (Territ.: Extraterr.) resp. in the years 1931, 1932, 1933, and 1934. The high density of haddock inside the boundary in the years before 1930 is very likely due to the protecting influence of the territory, whereas the slighter difference after 1930 is doubtless to be ascribed to the effect of the Danish seine.

A glance at Fig. 18, Paper 17, will give the main facts as regards the abundance of haddock. There is a very definite decline in the total landings after 1928 and in yields per unit of gear after 1927 (the lower graph of Fig. 18, Paper 17). There seems to have been a period of equilibrium with an annual yield of about 36,000 tons in the period 1923—1926, and a lower equilibrium with only 27,000 tons per annum is indicated in the years after 1932. The decrease can also be seen from the average catch (British steam-trawlers) per 100 hours' trawling (cwt.):

1922—1924.....	185.3
1925—1928.....	175.0
1929—1932.....	133.0
1933—1936.....	83.0
1937—1938.....	88.0

All evidence is thus supporting the general conclusion that the Icelandic haddock stock has decreased largely and that the decrease is due to overfishing as it coincides with a large-scale expansion of the fishing power. This is also stated by RUSSELL, who, after having shown that the landing per day's absence fell from 21.4 cwt. in 1919 to 5.0 cwt. in 1937, concludes: "..... that with something like 100 per cent increase in fishing as compared with the period 1920 to 1925 the total yield from 1932—1935 was much less than it was in the earlier period. That the density of the stock had decreased is clearly shown by the fall in the landing per day's absence to which we have already referred."¹

2. Plaice. In the case of this species there is the same marked difference in density inside and outside the territorial limit as we found when dealing with the haddock. This difference has, however, decreased in the later years as is shown by the following figures which are from STRUBBERG (Paper 20).

	1924—1929	1931—1934	1936—1937
Territorial.....	$\frac{88.0}{12} = 7.3$	$\frac{66.0}{3.2} = 20.6$	$\frac{68.0}{1} = 68.0$
Extra-territorial..	$\frac{7.5}{1} = 7.5$	$\frac{21.0}{1} = 21.0$	$\frac{71.0}{1} = 71.0$

(The two first figures in each equation show the number caught per trawling hour). STRUBBERG also points out (Paper 20) that the average size of fish in the individual samples has tended to decrease

¹ E. S. RUSSELL: The Overfishing Problem. Cambridge 1942, p. 42.

as time has passed. As emphasized by GRAHAM (Paper 17) there has been a similar equilibrium for the plaice in the years 1924—1927 as we found in the haddock stock. During this period the stock yielded about 6,000 tons per annum as against only ca. 5,000 tons in the period 1933—1935. There has been “... steady decrease in the landings per day's absence...”¹ and the same has been the case with the yield per 100 hours' fishing, which was 56 cwts. in 1922 but has fallen as shown by the following figures:

1922—1924.....	49	cwts.
1925—1928.....	41	»
1929—1932.....	31	»
1933—1936.....	21	»
1937—1938.....	18.5	»

RUSSELL points out further, that “there has also been a considerable diminution in the percentage of the large plaice. The percentage was 19 in 1921 and 1922, 17 in 1923 and 1924, and has subsequently fallen to an average since 1928 of approximately 9.”²

Further evidence relating inter alia to the decline is shown by the results given in Table 1.

As to the reason for the decline in the Icelandic stock of plaice we may refer to GRAHAM (Paper 17). He answers the question, what has happened between 1928 and 1931 with the following words: “I am afraid there is very little doubt that a major part, if not all, of the cause lies in the increase of fishing by steam trawlers. Between 1925 and 1931, covering the period when the adverse change took place, the number of hours fishing by British trawlers during the year increased by the very great amount of 81 %, and this high level has been maintained and lately exceeded”. As mentioned later by GRAHAM, there is no doubt that the development of the Icelandic seine-netting carries at least a part of the responsibility for the decline in the stock of plaice.

¹ E. S. RUSSELL 1942, p. 43.

² RUSSELL 1942, p. 43.

For particulars of the total yield of plaice from the Icelandic area as well as the yield per unit of effort, we refer to Paper 16, Paper 17 (Fig. 20) and Paper 20.

3. Halibut. STRUBBERG found the same changes in density on the two stations as in the case of the plaice (Paper 20). There were more halibut inside (8.5) than outside (5.2) the limit during the summer months in 1924—1929, but the reverse condition was found in 1931—1934, being 4.4 per trawling hour inside and 7.2 outside. In 1936—1937 there was on the other hand a relatively important preponderance on the territory, and the same was also the case in 1938—39. As shown in Fig. 22, Paper 17, the total yield of halibut was declining from 1923 to 1930. Since that year a very low equilibrium has been maintained. The yields per unit of gear show that the stock has been very seriously reduced during recent years. Thus the average catch per 100 hours by English steam trawlers was, in

1922—1924.....	11.7	cwts.
1925—1928.....	11.3	»
1929—1932.....	8.5	»
1933—1936.....	9.0	»
1937—1938.....	8.0	»

The yields of the long-line fisheries may be even more suitable as a measure of the size of the stock, as regards the halibut. Evidence from this, however, confirms the diminution of the stock of halibut. Thus the average catch per day's absence of British steam liners has been (tenths of cwts.):

1907—1910.....	91.8
1911—1914.....	51.8
.....	
.....	
.....	
1919—1921.....	69.3
1922—1924.....	81.7
1925—1928.....	49.3
1929—1932.....	18.8
1933—1936.....	27.3
1937—1938.....	28.5

Table 1. Plaice Markings in Faxa Bay.

	Period	Number	Percentage of Recaptures during 1st Year	Percentages of all Recaptures as to Nationality of Fishing Vessel		
				Great Britain	Iceland	Other Countries
Marking on Territorial Station	1908—1909	236	2.5	87.6	9.8	2.6
	1925—1927	596	6.5	77.5	18.0	4.5
	1932	150	38.0	10.9	89.1	0
	1938	150	44.7	11.7	88.3	0
Marking on Extraterritorial Station	1908—09	131	55.0	92.2	7.8	0
	1925—27	643	17.4	86.8	9.7	3.5
	1932	150	40.0	77.5	21.3	1.2
	1938	150	20.7	60.9	39.1	0

In Faxa Bay a distinct decrease of the stock of young halibut has been noticed in the course of the years as is shown in the following figures of catches in the same locality in various years.

No. per 10 trawling hours (50' ottertrawl)			
1908	1924—29	1931—34	1938—39
181	75	57	268

It is thus quite evident that we have to deal with a very marked reduction in the Icelandic halibut stock, lasting for many years followed by a sudden increase probably due to the very rich 1937—38 year-classes.

VI. Discussion

When considering what has been said above, we come to the conclusion, that at least some of the Icelandic stocks of fish, as for instance haddock, plaice and halibut, are depleted and need protection in order to give a maximum steady yield. Measures for protection have been provided by restriction of seine-netting to June—November on the territory and by mesh-regulations and provision of size-limits (Paper 26). But we must in this connection mention the effect of the general law, that most species mature later in northern waters than farther south. This produces a pronounced difference in the length of the "critical period" (viz. the time between entry into the fishery and sexual maturity) of the species considered here, the critical period being longer in Icelandic waters than farther south, for instance in the North Sea. The stocks of fish are consequently exposed to fishing one or more years more when still immature in Faxa Bay than is the case in, e.g., the North Sea. This subject is dealt with in Paper 18. It must be admitted, that there is a weak point in the arguments for the importance of the length of the critical period, namely the assumption, that the size of a year-brood is, *inter alia*, dependent on the number of fish spawning, at least when the stock is brought down to a very low level. This assumption, which is discussed in Paper 18, is not as yet generally admitted by scientists. Thus E. S. RUSSELL does not admit such a correlation when he writes: "Not very much is known about the causes of these fluctuations. But one thing is fairly certain — there is no necessary connection between the number of eggs produced in a particular spawning season and the amount of fry that survives; on the contrary poor spawning years have often been good brood years"¹. WILLIAM C. HERRINGTON, on the other hand, dealing with the Atlantic Haddock of North America concludes that "... the average production of young haddock is

¹ E. S. RUSSELL: The Overfishing Problem, Cambridge 1942, p. 58.

proportional to the abundance of spawners over a considerable range of egg-production". He states that "... the most important factors for the abundance of a year-brood are the size of the spawning stock and competition between adults and young — presumably competition for food —". HERRINGTON says further: "Studies of the quantities of eggs produced by fish of different sizes have shown that the number is roughly proportional to the weight of the fish. Furthermore, examination of thousands of haddock during the spawning season has shown that most of those of scrod size or larger are mature. Consequently the total number of eggs spawned during any season is approximately proportional to the abundance of marketable haddock during the winter and spring of that year"¹. Assuming that there is a positive relation between the number of spawners and the corresponding year-brood, it is evident that the longer duration of the critical period in northern seas with consequently higher total mortality before maturity will claim some means of additional protection as compared with more southern stocks.

In the case of halibut there are two reasons why protection through mesh regulations and size-limit cannot suffice. Firstly halibut is such a big fish that it is impracticable to protect it by means of mesh-regulations and size-limit for any reasonable part of its long critical period, secondly because trawled small halibut are very delicate. We therefore know of no other measure that promises better for the stock of halibut than the protection of important nursery grounds.

It may be objected to closure of an area for protecting purposes, that the fishing will be more intensive in the neighbouring areas so that the effect of the closure will be wiped out. This may be true provided that the age-composition and the density of the fish stocks on the protected area are approximately the same as outside it. But the argument is considerably weakened if the closed ground is of greater nursery value than the surroundings. The fish will be allowed to grow to greater size, and it should give higher catches of better fish outside the ground, which is just the intended result of protection.

It remains to be considered, why just the Faxa Bay should be selected as an area suited for an experimental closure. It is already pointed out above and may be emphasized here, that the bay is a prominent nursery ground especially for the most important species of food-fishes now overfished in the Icelandic area, according to the observations available. The bay is especially important as a nursery ground for halibut, the year-groups I—III being predominant

¹ W. C. HERRINGTON: A Crisis in the Haddock Fishery. United States Department of the Interior, Fish and Wildlife Service, Circular 4. Washington 1941 (The Abstract and p. 6).

and very abundant in comparison with other grounds outside the bay. Compared with other Icelandic areas the importance of Faxa Bay is shown by the catch of young halibut pr. 10 hours' trawling (50' ottertrawl), see Paper 8:

Faxa Bay	North Iceland	East Iceland	South Iceland
91	8	6	24

Evidence for the outstanding importance of Faxa Bay as a nursery as compared with another Icelandic bay, the Breida Bay, has been provided and is shown in Paper 21. Experimental trawlings carried out in Breida Bay for comparison with Faxa Bay confirmed what is common knowledge that Faxa Bay is a much more effective nursery ground than Breida Bay, especially for halibut and haddock, the number of fish caught per unit of gear being many times greater here than in Breida Bay and very young fish much more predominant.

Before stating briefly the argument that closure would be beneficial, it is worth noting that even if such experimental closure were in fact found to be of no benefit, this negative information would be of value as a guide in other cases where closure is or may be proposed. If experimental closure of Faxa Bay for a reasonable number of years fails to show benefit to the fishery, this kind of conservative effort may be considered as unavailing. But it should be kept in mind, that there is no other area known which is so predominantly a nursery of various species of fish.

The material from the experimental trawlings referred to above gives evidence of greater density of the stocks of valuable young fish inside the protection limit than outside it. There seems no doubt that were protection afforded to the whole bay, many suitable grounds would come to carry stocks like those now found within the 3-mile limit. At present the potentially rich nursery grounds outside the limit are not used to full advantage, and there can be little doubt that the fishery thereby loses profit.

In the case of plaice and haddock it may be expected that fisheries outside Faxa Bay would yield a greater weight of fish annually if the nursery grounds provided by Faxa Bay were protected so that the fish might grow to a greater size than at present before being caught. Another possible benefit is that an increased number of fish of those two species may reach sexual maturity, as an ultimate result of protection of the younger ages. One or both of these benefits may be expected to be realized. A very great increase in the rate of fishing in the track of emigration from the bay may subsequently remove the benefit, but the effort would have to be of a magnitude that is hardly to be expected.

At the same time it must be understood that protection of Faxa Bay alone is not expected to remedy all the overfishing of plaice and haddock

in Icelandic waters. It is however expected to improve the position.

In the case of halibut the position is more serious, and the argument in favour of closing the bay is clear. There is little doubt that Faxa Bay is one of the most important nurseries for halibut in the North Atlantic region. On attaining sexual maturity, or perhaps sooner, all these halibut leave the bay. These fish scatter over a very large area, making it still more likely than in plaice and haddock that an increased proportion will escape fishing and survive to breed or reach a more profitable size, if the bay is closed. That is to say, there is in this species less cause to apprehend any interference with the two kinds of benefit hoped for, which can be expressed shortly as: "Better fish and greater numbers of them".

Turning now to consider the international interests in Faxa Bay, we will refer to what was said about the fisheries and to Paper 15. Table 2 shows that a proposal to exclude trawlers and seine-netters would fall most heavily on the nationals of Great Britain and Iceland. These two countries are together responsible for about 90 % of trawling in the bay and Iceland alone is responsible for practically all the seine-netting, as has already been stated above.

Table 2. The Different Nations' Relative Share (in Percentage) in the Use of Different Fishing Implements in the Faxa Bay Proper in the Years 1927—1937. Observations of Patrol Vessels.

Nationalities	Trawl	Steam and Motor-liners	Longline Motor-boats	Hand-line	Seine-net
Icelandic...	28.3	55.5	94.4	60.8	100.0
Norwegian..	0.1	22.3	2.8	—	—
Swedish....	—	—	2.8	—	—
British.....	62.3	0.9	—	0.7	—
German....	6.2	—	—	—	—
French.....	0.8	—	—	—	—
Dutch.....	0.1	—	—	—	—
Belgian....	0.1	—	—	—	—
Spanish....	0.3	—	—	—	—
Faroe Isls..	1.8	21.3 ¹	—	38.5	—
Number....	897	221	36	140	86

¹ Motor-liners only.

A further illustration of the extent of the sacrifice asked from these two nations is provided by the figures given on page 10 of this report. As regards Great Britain further information is given by TÄNING in Paper 19, where the average annual value (1932—1936) of the catch of cod, haddock, plaice, halibut and lemon sole of both English steam trawlers and liners is found to be about £ 160,000. The value for Iceland would not be very much less, especially in recent years, and there is no doubt that this bay would normally become of increased value for Icelandic trawling and seine-netting owing to the planned increase of the fishing fleet in the near future.

It remains still to consider two questions:

(a) Would it be necessary to close *the whole bay* in order to get full advantage of its nursery grounds, or would it be sufficient to close *the southern section*?

(b) *What kind of gears* should be removed from the bay during the closure and which ones should be allowed?

At the meeting held in Reykjavik in July 1939 it was considered whether a division of the bay could be made if the closure of the whole bay is impracticable. "It was agreed that a line from Gardskagi towards Snæfellsjökull to a point situated $64^{\circ}17'N.$ — $23^{\circ}00'W.$ and a line from this position through Borgarfjörður to the northern end of Hafnarfjall would from a biological point of view form a natural and also a practical boundary between the most important southern nursery grounds and the northern areas which are of minor importance as nursery grounds". In the opinion of the Sub-Committee, however, such a partial closure would place difficulties in the way of obtaining a clear result from the experiment. Although the above proposed section covers the most valuable nursery grounds the fish which has benefited by the closure will when leaving the area, have better opportunity to escape and spread if the protected area is large. If it was found more practicable to limit the protection to the southern part of the bay it might perhaps be recommended to close the whole bay seasonally for instance during the summer months or during all the time seine-netting would be allowed on the territory.

In Paper 23 the composition of catches from different gears, as to species of fish, has been compiled. It is shown there that longline fishing affects the young stages of fish in the bay to a very slight degree only and the same is the case with the handline. The longline fishing is for instance predominantly a fishery for large cod, as is shown in the tables in Paper 23.

It is quite clear, that trawling and seine-netting of every kind ought to be prohibited in the bay during the period of closure. On the other hand it would not be necessary to exclude longline, handline, cod-nets, lumpsucker-nets and herring drift-nets, because the removal of these gears would be of practically no use for the benefit of plaice, young haddock and halibut.

The closure of Faxa Bay is primarily intended for the protection of young haddock, plaice and halibut and to be run as an international experiment. The period of closure should be long enough to cover at least the whole critical period of one generation, which for halibut is at least 7 years. It is also necessary to allow time for trends to be observed in spite of annual fluctuations in the fisheries. A period of 10 years would therefore be required for the experiment and probably up to 5 years more before any further decision

taken on the opening or closing of the bay could be ratified.

During the 10 years of observation scientific work in the bay should be of two kinds:

The first kind of scientific work would aim at assessing the effect of closure on the fisheries in Icelandic waters.

The species concerned are haddock, plaice, halibut and lemon sole, of which it is hoped that appreciably increased weight of fish will be taken in fisheries outside the bay, more than compensating for the reduction of fisheries inside the bay and the cost of policing.

The means for assessing this benefit are:

(a) marking, of plaice and lemon soles of 25 cm. length or greater, and of halibut of 30 cm. length or greater. Marking of haddock, or of smaller flat-fish, would not give profitable returns, owing to the smaller chance of survival of the process of marking.

(b) Commercial statistics of fisheries in Icelandic waters.

Marking could show whether or not closure of the bay had caused appreciable increase in migration from the bay to other fishing areas.

Thus, if regular fishing in the bay with standard gear year by year, were always carried out for the same number of hours, and if the same proportion of the catch were always marked, the number of fish recaptured by fishermen elsewhere would be an index of the supply of fish from the bay to the other fisheries.

If this number of fish recaptured showed a significant upward trend during the 10 years of observation, the closure of the bay would be known to have done some good.

The question would still remain whether the increased emigration was of sufficient magnitude to compensate for the sacrifice of fisheries within the bay — a sacrifice of approximately £ 300,000 worth of fish per annum in the inter-war years.

It is therefore necessary to estimate the amount of the increase in emigration, this could only be done by obtaining the proportion of the catch at Iceland that is derived from the nursery in Faxa Bay. Given that information, and the quantity and value of the total catch in Icelandic waters, it would be possible to evaluate the emigration from the Faxa Bay.

For this purpose it would be necessary to mark fish taken by even fishing on all the nursery grounds round Iceland.

The second kind of information is designed to obtain general information of changes, so that no large factor in the experiment may be overlooked.

At the meeting in Reykjavik, July 1939, the present members of the Faxa Bay Sub-Committee came to an agreement as regards the scientific investigations to be carried out during the closure. The programme should be carried out by

research vessels or hired fishing vessels and runs thus:

"A. Trawling should be carried out quarterly in the following localities (see Fig. 1):

1. Fixed territorial station (1 on the figure) and a station off Engey (2).
2. Fixed extraterritorial station (3) and in localities worked now by commercial trawlers east of Sydra Hraun (4) and north-east of Sydra Hraun (5).
3. On a locality just outside the bay: viz. in the Midnessjór (6).

The material should be used for a comparative study of alterations of the density of the stocks of the important species of food-fishes (plaice, lemon sole, halibut, haddock and cod) and age- and growth-investigations should be carried out.

Moreover seasonal migration of halibut, plaice and haddock should be considered, and if possible, also the immigration of pelagic fry in the bay, especially the postlarval stages of the halibut near the bottom stage.

B. Bottom sampling should be carried out in the localities where trawling experiments were made and also on three lines with 10 stations in each, crossing the southern area from south to north. Bottom sampling should be made once a year.

C. Hydrographical observations should be made on the trawling stations and as far as possible every month on the routine stations off Skagi and Akranes.

D. Catches from longline and handline fishing in the closed area should be measured and statistics of these fisheries should be collected."

VII. Recommendations

- A. 1. It is recommended that an international experiment on the benefit of closure of nursery grounds should be carried out in Ice-



Fig. 1. Proposed Stations for Quarterly Experimental Trawling during Closure of the Bay.

landic waters. For this purpose Faxa Bay within a line joining Gardskagi to Malarrif is recommended.

- 2.¹ In the area every kind of trawling or seine netting should be prohibited; compensation should be made to the fisheries and international policing at maximum efficiency is essential to the experiment.
3. The period of the experiment should be 10 years and the bay should remain closed for an additional 5 years in order to provide time for ratification of any agreement on its permanent closure or opening.
4. As a first essential the investigations given above (§ A—D) should be put in hand without delay, in order to provide a firm basis for an experimental closure.
- B. That the present report and annexed papers be published.

¹ Passed by the Council amended as follows: "In the area every kind of trawling or seine netting should be prohibited in which case international policing at maximum efficiency is essential to the experiment."

B. PAPERS

The preceding report is mainly based upon the following 26 papers, which have been prepared upon request of the Faxe Bay Sub-Committee. The papers have been arranged in accordance with the subjects they are dealing with and can conveniently be divided into four groups. The first group, consisting of Papers 1—3, may be regarded as an introduction, dealing with the first start of the question and the research work, which has been carried out. In the second group (Papers 4—12) a description is given of the Bay, its hydrography, bottom fauna, fish life in general and the biology of the five most important food-fishes in particular. The third and by far the largest group deals with the commercial and experimental fishing in the Bay (Papers 13—23) and finally the fourth group, consisting of 3 papers (24—26), gives an outline of legislative provisions.

The different ways in which the various authors have approached the different subjects may seem to give the survey a somewhat heterogeneous character, but there is this advantage, on the other hand, that the special knowledge of each author

and the different points of view from which the sections have been written, will better serve to give an insight into the problems than a document prepared by a single author.

It was originally planned that the Faxe Bay Sub-Committee should finish the work in the course of two or three years. Most of the papers had therefore been prepared before the war curtailed the work. When the Sub-Committee was asked to commence again, about six years later, it was found necessary to include additional data in order to bring the papers up to date as far as possible. In many cases the additional material has been welded into the original papers, which have thus been completely revised. In other instances this has not been possible, so that it has become necessary to add the new information in an appendix to the corresponding paper.

Finally it should be mentioned, that some of the papers, which according to their subject did not need to be brought up to date, have been thoroughly revised with the permission of the author.

ON AN EXPERIMENTAL REGULATION OF FISHERY WITHIN A LIMITED AREA OUTSIDE THE TERRITORIAL LIMITS (FAXA BAY)

(Distributed at The International Conference on Mesh Regulations and Size Limits for Fish,
London 17th—23rd March 1937)

Iceland, the home of one of the largest fishing industries of Europe is strongly interested in the most rational exploitation of the fishery. The Icelanders therefore highly appreciate the efforts made by the International Council for the Exploration of the Sea, together with the initiative of Great Britain, for the introduction of a minimum mesh for bottom-fishing gear and size limits for fish on the markets of the world, in order to protect the young of the food fishes and to encourage a more rational fishery. In the case of Icelandic waters, however, it seems doubtful whether the result of these efforts will be satisfactory. This appears, among others, from the fact that in recent years the weight of fish caught by British trawlers per 100 hours trawling has decreased considerably.

As regards **plaice** it will suffice to refer to TÅNING who states the percentage recaptures of marked plaice and the average catches per 100 hours trawling in Faxa Bay in the years 1922 to 1933 (TÅNING, 1935, p. 12). From the plaice marked in Faxa Bay in the years 1925—1927, 22 % only were caught outside the territorial limit, of those marked in 1932, as many as 53 %. This shows very clearly the increased toll taken in recent years of the stock by the fishery. TÅNING says (loc. cit.): "This coincides with a very pronounced fall in catch per 100 hours trawling. During the years 1922 to 1933 we have the following cwts. per 100 hours fishing by English steam trawlers: 56, 50, 42, 48, 44, 42, 30, 30, 39, 30, 26, 20; the catch per 100 hours having thus decreased nearly to that of the North Sea fishery. The increased intensity of the fishing is obviously too strong for the stock available".

As to **haddock**, the average weight fished off Iceland per 100 hours trawling has decreased from 243 cwts. in 1922 to 85 cwts. in 1935 (Statistical Tables 1923—1936). Dividing these years into two periods we get an average weight of 179 cwts. per 100 hours trawling for the years 1922 to 1928 as against 111 cwts. for 1929—1935, i.e., the average catch per 100 hours trawling has decreased by 38 %.

The reason why the actual regulations do not seem to be sufficiently effective, as far as Icelandic waters are concerned, must undoubtedly be looked for, among others, in the conditions prevailing in our northern waters, where the fish grow more slowly than in the North Sea, for instance, as also the sexual maturity is reached later, and consequently the death rate of the younger stages — before maturity — is relatively great.

According to scientific experiments the greater part of the Icelandic food fishes consists chiefly of



Fig. 2. Chart of Iceland showing Faxa Bay.

indigenous stocks and therefore the question regarding the protection of these stocks coincides with the question regarding a continued profitable fishery. At Iceland, therefore, the general feeling is in favour of rationalizing the fishery as much as possible, even if further restrictions, to begin with, should prove to be prejudicial to the fishermen. There is an opinion for closing a special limited area, the Faxa Bay, which is known to be an important nursery ground for food fishes, in order to find out which importance may be attached to this kind of protection. Those species that specially seem to call

Table 3. Relation between Fish above and below the Size Limit 23 cm. from various places in the Faxa Bay.

“Thor” 1935—1936. 75-feet Otter-Trawl without fine-meshed cover on the cod-end.

St. No.	Position		Date	Fish	Number		Total	%	
	N. Lat.	W. Long			above	below		above	below
193	64°06'2	22°38'8	18.7.'36	<i>Gad. call.</i>	32	229	261	12.3	87.7
				<i>aelelf.</i>	13	47	60	21.7	78.3
				<i>Hipp. vulg.</i>	17	57	74	23.0	77.0
				<i>Pl. plat.</i>	10	193	203	4.9	95.1
				<i>lim.</i>	11	26	37	30.0	70.0
				<i>— micr.</i>	6	59	65	9.0	91.0
195	64°05'2	22°25'20	18.7.'36	<i>Gad. aelelf.</i>	5	1	6	83.3	16.7
				<i>merl.</i>	3	0	3	100.0	0.0
				<i>Hipp. vulg.</i>	2	2	4	50.0	50.0
				<i>Pl. plat.</i>	22	116	138	16.0	84.0
				<i>— lim.</i>	8	286	294	2.7	97.3
				<i>— micr.</i>	5	27	32	15.6	84.4
265	64°19'8	22°36'2	12.8.'36	<i>Gad. aelelf.</i>	0	12	12	0.0	100.0
				<i>Pl. lim.</i>	8	103	111	7.2	92.8
				<i>— micr.</i>	1	1	2	50.0	50.0

Table 4. Quantity of Plaice, Haddock and Halibut caught during trawling in Faxa Bay 1924—1934.(Territorial and extra-territorial waters.)¹

Species	Month	Vessel	Territorial waters			Extra-territorial waters		
			Total Number ind.	Number of hours of trawling	Number per hour	Total Number ind.	Number of hours of trawling	Number per hour
Plaice	May—August 1924—34	“Dana” and “Por”	18,984	258 ³ / ₄	73	2,788	262 ⁵ / ₆	11
Haddock	—	—	24,806	256 ³ / ₄	97	5,011	262 ⁵ / ₆	19
Halibut	—	—	2,010	258 ³ / ₄	8	1,487	262 ⁵ / ₆	6

¹ The material is taken from the investigations made in Faxa Bay, under the direction of Dr. B. SÆMUNDSSON, Reykjavik, and by the Danish Commission for Fishery Investigations, and has kindly been put at my disposal by Dr. Å. V. TÅNING.

Table 5. “Thor” 1927—1929. Faxa Bay. Number per 10 Trawling hours in territorial and extra-territorial waters.

Species	Station	February		March	Apr.	May		June	July	Aug.	Sept.	October		1929
		1928	1929	1927	1927	1928	1929		1929	1928		1927	1928	
Plaice	Intra-	73	1,025	436	279	384	282	—	640	307	—	232	28	661
	Extra-	25	51	421	129	47	55	—	29	54	—	51	37	100
Haddock	Intra-	32	18	0	1	119	115	—	292	113	—	172	3	236
	Extra-	0	0	0	26	0	13	—	6	29	—	6	21	66
Halibut	Intra-	11	94	19	18	56	75	—	63	43	—	39	6	78
	Extra-	9	3	14	11	9	22	—	16	47	—	34	41	14

for further protection in Icelandic waters are plaice, haddock and halibut. The Icelandic trawlers who land the bulk of these species, and who, consequently, were expected to be opposed to the protection in special areas, are, on the contrary, interested in the experiment, as can be seen from the following resolution, voted at a meeting of the association of trawler captains "Skibstjórafélagid Aldan" in Reykjavik: "At a meeting of the association of trawler captains "Skibstjórafélagid Aldan" on December 23rd, 1936, the desirability of protecting Faxa Bay against trawling for a certain period of years as an experimental measure is unanimously recognized. The meeting leaves it to the board of the association to work for that issue".

As to an Icelandic area specially suited for such an experiment Faxa Bay at the south-west coast is recommended for the following reasons: —

(1) In this bay — especially in summer and in its southern part where the bottom is soft — great quantities of fish are caught that are unfit for sale (below 23 cm.). This appears, among others, from my investigations from the patrol vessel "Thor", the results of which, as to 3 stations, are given in Table 3. The bay is a very important nursery ground for plaice, haddock and, above all, halibut (P. JESPERSEN, 1936).

(2) The territorial fishery is relatively small here, as can be seen from the relatively great quantity of fish inside the territorial limit where fishery takes place with other implements than trawl, compared to the much smaller quantity outside the limit where trawling is carried out. The main lines illustrating this difference are given in Table 4 which is worked out on the basis of Danish investigations through many years.

(3) The bay offers good conditions for feeding great populations of fish, to judge from the quantitative investigations of the bottom fauna carried out by the Danish Commission for Fishery Investigations (SPÄRCK).

(4) The Icelandic trawler fishermen are in favour of the Faxa Bay being chosen as the object of an experiment.

(5) The bay being a well frequented water the experiment could easily be carried out and controlled.

The Icelandic government will continue to follow with the greatest interest international work with a view to promoting rational fishery and protecting against overfishing the stocks of fish in the various waters. In my opinion it would be advisable to make an experiment to protect limited nursery grounds, and Faxa Bay, Iceland, is especially recommended as an object of experiment because scientific investigations made principally by Danish scientists have provided the necessary proof for the fitness of the bay as such an area.

p. t. London, March 17th, 1937.

(Signed) ARNI FRIDRIKSSON.

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Statistical Tables 1923—1936. Ministry of Agriculture and Fisheries.
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Paper No. 2

March 1937

PROPOSAL FROM THE ICELANDIC DELEGATION

(Distributed at the International Conference on Mesh Regulations and Size Limits for Fish,
London 17th—23rd March 1937.)

To promote the work for the better protection of the stock of fish in the sea The International Conference on Mesh Regulations and Size Limits for fish submit to The International Council for the Exploration of the Sea to include in the Agenda for its next meeting the question of the protection of Faxa Bay, Iceland, for a shorter or longer period. Furthermore, to arrange for such supplementary

scientific investigations as may be considered necessary to ascertain, as far as possible whether by the means of such protection of the Faxa Bay, the stock of fish in the seas around Iceland or even in other parts of the sea can be preserved or increased.
19th March, 1937.

(Signed) SYEINN BJÖRNSSON.
ARNI FRIDRIKSSON.

TABLES REVIEWING RESEARCH WORK CARRIED OUT IN FAXA BAY DURING THE YEARS 1924—45

BY

ARNI FRIDRIKSSON and Å. VEDEL TÅNING

The following lists were originally prepared for the benefit of the members of the Sub-Committee on the Faxe Bay Question in order to give a survey of the different research work carried out in the bay during the years 1924—1937. Now the lists have been brought up to date, so that they include a review of all fieldwork in the Bay until 1945 (incl.). Until the year 1938 most of the work was done by research vessels, but in 1939 fishing vessels were also chartered for experimental trawling ("Geir") and seine netting. In 1940 a commercial trawler was chartered to carry out the routine work in the Bay ("Reykjaborg") and in 1945 two small motor-trawlers ("Skálafell" and "Bragi") were engaged.

Table 6 gives a review of the different implements used in the various years mostly by research vessels working in the area, and moreover a review of the marking experiments, of which however Table 9 gives further particulars. Collection of phytoplankton and hydro-

graphical data is not mentioned in Table 6; hydrographical data have, however, been procured every year.

The tables marked 7 A, B, and C give a review of the experimental trawlings; 7 A and B of the trawlings carried out on the fixed stations, respectively inside and outside the territorial limit in the southern part of the Bay. Table 7 C gives some supplementary stations from other localities in the Bay. The total catch of the five principal food fishes is given (in numbers of fish) for each station.

Table 8 shows in which months the different vessels have operated in the Bay during the period mentioned; it is apparent that few experimental trawlings have been made during the months November to April (inclusive).

Table 9 gives as mentioned above a review of the different marking experiments of food fishes in the Bay; the table includes all experiments known from the Bay.

Table 6. Review of Research Work carried out by the various Research Vessels in Faxe Bay during the years 1924—1945.

Year	Fishing Gears operated						Marking Experiments					
	Trawl ¹	Eel hand seine	Lines	Hand shove net	Bottom sampler	Pelagic young fish net	Plaice	Lemon Sole	Halibut	Cod	Haddock	Catfish
1924	D	D	D	D	—	D	—	—	—	—	—	—
1925	D, E	D	—	—	—	D	D	E	E	T	E	—
1926	D	D	—	—	D	D	D	—	—	—	—	—
1927	D, T	D	—	D	D	D	D	—	—	—	—	—
1928	T	—	—	—	—	—	—	—	—	—	—	—
1929	T	—	—	—	—	—	—	—	—	—	—	—
1930	—	—	—	—	—	—	—	—	—	—	—	—
1931	D	D	—	—	—	—	—	—	—	—	—	—
1932	D	D	—	D	D	—	D	—	—	—	—	—
1933	D	D	—	D	—	D	—	—	—	—	—	D
1934	D	D	—	—	—	D	—	—	—	—	—	D
1935	X	—	—	—	—	—	—	—	—	T	—	—
1936	B, N, T	—	—	—	—	—	—	—	—	—	—	—
1937	N, T	—	—	—	—	—	—	—	—	—	—	—
1938	D, T	—	—	—	T	—	D, T	—	D	—	—	—
1939	D, T, X	—	—	—	D	D	T	—	—	—	—	—
1940	X	—	—	—	—	—	—	—	—	—	—	—
1945	X	—	—	—	—	—	—	—	—	—	—	—

¹Herringtrawl not included. B = "George Bligh"; D = "Dana"; E = "Explorer"; N = "Nautilus"; T = "Thor"; X = other vessels.

Table 7. Survey of Trawling Experiments in extraterritorial and territorial waters.¹ Catch of Principal Food Fishes.

A. Faxa Bay, territorial. (Central position: 64°04'N. 22°35'W.).

Vessel	St. No.	Year	Date	No. of trawling hours	Total number of:				
					<i>Pleur. plat.</i>	<i>Micr. kitt.</i>	<i>Hipp. hipp.</i>	<i>Gadus aeglef.</i>	<i>Gadus call.</i>
"Dana"	2 142	1924	25—27/6	17	2,215	237	510	1,658	1,189
"	2 170	"	6—7/7	15 3/4	1,281	267	187	5,294	8
"Explorer"	33 (892)	1925	24/6	1	147	—	18	42	691
"	34 (903)	"	25/6	1	750	10	94	208	10
"Dana"	2 445	1925	1—6/8	20	3,115	196	73	3,905	205
"	2 640	1926	21—24/6	28	990	181	121	3,257	63
"	2 682	"	1/7	3	282	38	19	247	2
"	3 128	1927	20—21 + 25—27/7	30	3,676	354	303	1,650 ²	42
"Thor"		1927	1—2/8						
"		"	2—4/3	20	871	8	38	—	102
"		"	22—23/4	16	447	35	29	2	141
"		"	15—18/10	20	463	74	78	349	33
"		1928	22—25/2	20	147	5	22	64	28
"		"	4—6/5	20	768	61	112	237	9
"		"	5—7/8	20	614	104	86	226	1
"		"	11—16/10	20	56	3	11	6	4
"		1929	17—19/2	20	2,050	4	188	35	10
"		"	7—9/5	20	565	83	149	230	20
"		"	18—25/7	18	1,259	111	115	536	1
"		"	8—10/10	20	1,321	263	156	471	62
"Dana"	4 241	1931	22—26/7	20	2,602	267	115	804	9
"	4 418	1932	1—5/7	28	553	341	164	2,025	9
"	4 689	1933	18—21/8	11	568	107	36	1,554	2
"	5 092	1934	11—12/5	8	510	36	20	2,994	26
"George Bligh"	5 450	1936	5/7	3 1/2	255	658	53	220	331
"Nautilus"		1936	2/6	2	114	35	29	380	6
"Thor"	193	1936	18/7	1 1/3	37	74	65	60	261
"	195	"	"	1	138	32	4	6	—
"	6—9	1937	24—25/5	7 1/3	1,589	364	231	4,477	18
"	91	"	28/10	13	869	323	93	1,200	362
"Nautilus"	10	1937	26/5	12	56	41	18	101	672
"Thor"	93	1938	15—16/2	10	1,771	74	80	344	83
"	16	"	23/6	4	363	265	102	1,302	621
"	24	1938	26/6	1	1	126	—	2	2
"Dana"	5 970	"	12—13/7	10	445	298	91	415	18
"Thor"	62	"	14/12	10	2,155	234	131	197	12
"	67	1939	29—31/3	10	2,671	169	239	3,643	7,059
"	88	"	17—18/5	5	1,263	730	578	2,829	70
"Geir"		"	25—26/7	3	443	99	388	1,346	270
"Dana"	6 149	"	27/7	1	105	14	32	34	11
"	6 176	"	28—29/7	6	387	349	337	236	93
"R. borg"	1	1940	1—2/11	11	277	157	228	3,044	8,440
"Skálaf."	1	1945	28/2—1/3	10	2,116	26	273	14	80
"Bragi"	1	"	28—30/5	10	590	126	71	2,822	665
"	1	"	5/9	10 5/6	427	417	196	4,101	126
"	1	"	16—17/11	10	202	51	167	2,314	160

¹ Material from fine-mesh-net covering not included.

² Material from 28 hours trawling only.

B. Faxa Bay, extraterritorial. (Central position: 64°08'N. 22°23'W.).

Vessel	St. No.	Year	Date	No. of trawling hours	Pleur. plat.	Micr. kitt	Hipp. hipp.	Gadus aeglef.	Gadus call.
"Dana"	2 129	1924	12—13/6	12	156	37	103	250	323
"	2 139	"	21—25/6	39	583	159	391	830	1,451
"Explorer"	32 (891)	1925	24/6	1	32	14	11	15	14
"Dana"	2 443	1925	30—1/8	15	79	42	88	137	348
"	2 446	"	7/8	4	2	2	8	52	—
"	2 648	1926	25/6	20	41	3	28	82	56
"	2 659	"	27/6	6	22	1	11	—	6
"	3 127	1927	18—20 + 27/7	25	353	12	234	655	173
"Thor"		1927	2—4/3	20	842	—	27	—	3
"		"	22—23/4	20	258	7	21	52	177
"		"	15—18/10	20	124	3	68	12	112
"		1928	22—26/2	20	49	—	18	—	21
"		"	4—6/5	20	93	—	17	—	2
"		"	5—7/8	20	108	1	94	58	6
"		"	11—16/10	20	73	3	81	42	6
"		1929	17—19/2	20	102	—	9	—	55
"		"	7—9/5	20	111	2	44	25	20
"		"	18—25/7	18	53	15	29	10	31
"		"	8—10/10	20	199	15	27	130	48
"Dana"	4 243	1931	27—29/7	20	212	234	231	751	47
"	4 423	1932	3—6/7	28	432	282	96	1,121	229
"	4 691	1933	21—22/8	11	452	166	85	769	179
"	5 095	1934	14/5	4 5/6	85	25	28	263	15
"George Bligh"	5 451	1936	6/7	4	495	408	231	4	142
"Nautilus"		1936	2/8	2	33	36	1	3	103
"Thor"	1 5	1937	23—24/5	10	419	224	33	43	1,222
"	90	"	27/10	14 1/2	846	11	90	189	232
"Nautilus"	11	1937	25/5	2	220	12	39	18	120
"Thor"	92	1938	14—15/2	10	832	1	123	7	76
"	15	"	22/6	8	172	144	49	374	677
"Dana"	5 968	"	6/7	10	60	53	66	122	153
"Thor"	61	"	13/12	10	1,537	1	129	0	8
"	66	1939	28—29/3	10	2,185	5	21	10	907
"	87	"	18—17/5	5	225	24	140	9	54
"Geir"		"	25—26/7	3	10	303	125	29	1,084
"Dana"	6 177	"	29/7	6	73	34	255	56	2
"	6 150	"	27/7	1	7	19	16	8	1
"Harald"		"	26/7	1	584	197	68	54	2
"R.borg"	2	1940	3—4/11	3 1/6	152	2	165	131	23
"Skálaf."	1	1945	28/2—1/3	10	287	0	56	19	7
"Bragi"	2	"	29—30/5	10	38	59	17	189	904
"	11	"	4—5/9	11	489	85	381	3,599	411
"	11	"	17/11	10	517	1	146	1,043	85

Material from fine-mesh-net not included.

C. Faxa Bay, various extraterritorial and territorial stations.

Vessel	St. No.	Position N. W.	Year	Date	No. of trawling hours	Pleur. plat.	Micr. kitt	Hipp. hipp.	Gad. aegl.	Gad. call.
"Dana"	2 133		1924	1 ⁹ / ₆	2	3	2	—	40	4
"	2 134		"	"	2	—	4	—	26	5
"	2 442	64°13' 22°18'	1925	3 ⁰ / ₇	1 ¹ / ₂	1	2	1	3	3
"Explorer"	28 (867)	64°33' 23°26'	1925	2 ¹ / ₆	1 ¹ / ₂	—	2	—	73	28
"	31 (883)	64°18' 22°14'	"	2 ⁴ / ₆	1 ¹ / ₂	7	1	1	72	94
"	134 (901)	64°05.3' 22°28.3'	"	"	1 ¹ / ₂	23	42	8	337	10
"Dana"	2 667	64°11.7' 21°57.3'	1926	3 ⁰ / ₆	3	232	2	54	30	21
"	2 672	64°14' 22°19'	"	1 ¹ / ₇	3	3	2	3	1	15
"	3 188	64°12' 21°56'	1927	4 [—] 5 ⁵ / ₈	5	1,472	14	209	384	2
"	3 200	64°25.3' 23°05'	"	5 [—] 6 ¹ / ₈	3	1	7	—	80	15
"	4 419	64°11.7' 21°59.5'	1932	2 ⁷ / ₇	2	9	2	17	87	—
"Geir" ²		64°17' 22°19'	1935	2 ⁸ / ₈	2 1 ¹ / ₂	513	?	?	?	?
"		64°20.5' 22°55'	"	2 ⁹ / ₈	3	191	?	28	?	?
"		64°18' 22°30'	"	3 ⁰ / ₈	5	?	?	46	?	?
"		64°21' 22°41'	"	3 ¹ / ₈	5	?	?	?	c. 442	?
"		"	"	1 ¹ / ₉	7 1 ¹ / ₂	?	?	98	?	?
"		"	"	2 ⁷ / ₉	2 1 ¹ / ₂	121	?	66	?	?
"		64°20.5' 22°55'	"	3 ¹ / ₉	2 1 ¹ / ₂	?	?	30	?	?
"		64°15' 22°31'	"	"	5	160	?	?	109	?
"		64°18' 22°30'	"	4 ¹ / ₉	2 1 ¹ / ₂	79	?	44	92	?
"		64°07' 22°20'	"	5 ¹ / ₉	5	?	?	19	535	?
"		64°21' 22°41'	"	6 ¹ / ₉	5	?	c. 120	103	?	?
"George Bligh"	5 436	64°04.5' 22°29'	1936	3 ⁰ / ₆	3 ¹ / ₄	26	123	32	7	70
"Thor"	265	64°19.8' 22°36.2'	1936	12 ¹ / ₈	1	—	2	—	12	—
"	86	64°45.6' 23°22.7'	1937	23 ¹ / ₁₀	c. 1 ¹ / ₂	8	1	—	2	12
"	87	64°42' 22°38'	"	23 [—] 25 ¹ / ₁₀	6	8,333	—	4	1	13
"	88	64°40' 22°43'	"	26 ¹ / ₁₀	2	231	—	17	76	92
"	89	64°26' 23°12.5'	"	"	2	1	169	3	144	26
"Thor"	94	64°25' 23°11'	1938	17 ¹ / ₂	4	10	20	7	369	462
"	95	64°22.3' 21°39.1'	"	18 ¹ / ₂	1	1	—	—	—	—
"	96	64°38.7' 23°45'	"	18 ¹ / ₂	1	7	—	1	—	2
"	17	64°25' 23°13'	"	23 ¹ / ₆	2	—	2	—	1	73
"	18	64°39.5' 22°42.2'	"	23 ¹ / ₆	2	709	12	16	23	63
"	19	64°43.5' 22°30.6'	"	24 ¹ / ₆	2	1,376	—	11	—	10
"	20	64°21.3' 21°43.4'	"	24 ¹ / ₆	1	197	—	—	—	105
"	21	64°25' 23°18'	"	25 ¹ / ₆	2	—	3	—	—	26
"	23	64°25' 23°18'	"	26 ¹ / ₆	2	—	9	—	1	80
"Dana"	6,144	64°24' 22°27'	"	26 ¹ / ₇	1 ¹ / ₂	3	8	—	2	5
"Thor"	63	64°25.2' 23°18.8'	"	15 ¹ / ₁₂	2	—	—	3	100	16
"	64	64°39.5' 22°42.2'	"	15 ¹ / ₁₂	2	7	—	—	—	10
"	65	64°43.5' 22°30.6'	"	16 ¹ / ₁₂	2	21	—	—	—	—
"	68	64°25.2' 23°18.8'	1939	1 ¹ / ₄	2	2	15	1	15	43
"	69	64°39.5' 22°42.2'	"	1 ¹ / ₄	2	61	—	2	—	53
"	70	64°43.5' 22°30.6'	"	1 ¹ / ₄	2	170	—	1	—	—
"	71	64°21.3' 21°43.4'	"	2 ¹ / ₄	2	305	—	1	—	—
"	72	64°11.7' 21°57'	"	2 ¹ / ₄	2	183	2	32	1	344
"	86	64°25.2' 23°18.8'	"	16 ¹ / ₅	2	1	2	2	1	20
"	89	64°21.3' 21°43.4'	"	19 ¹ / ₅	2	253	3	13	—	957
"	90	64°43.5' 22°30.6'	"	27 ¹ / ₅	2	348	—	2	—	23
"	91	64°39.5' 22°42.2'	"	27 ¹ / ₅	2 1 ¹ / ₂	306	9	5	42	30
"Geir"		64°11.7' 21°57'	"	25 [—] 26 ¹ / ₇	2	55	17	145	718	193
"Harald"		64°11.7' 21°57'	"	26 ¹ / ₇	1	25	—	13	114	—
"Reykjaborg"	3	64°12' 25°15'	1940	2 ¹ / ₁₁	2	70	3	69	—	1
"	4	64°17' 22°23'	"	2 [—] 3 ¹ / ₁₁	8 1 ¹ / ₂	315	12	201	300	320
"	4 a	64°18' 22°30'	"	3 ¹ / ₁₁	2	60	25	243	196	—
"	4 b	64°22' 22°40'	"	3 ¹ / ₁₁	2 1 ¹ / ₆	47	55	88	250	32
"	5	64°25.2' 23°18.8'	"	3 ¹ / ₁₁	2	—	6	3	62	11
"Skálafell"	1	64°26' 23°12.5'	1945	2 ¹ / ₃	4	—	11	—	32	335
"Bragi"	3	64°26' 23°12.5'	"	30 ¹ / ₅	4	7	60	—	88	23
"	4	64°40' 22°38'	"	30 ¹ / ₅	2 2 ¹ / ₃	457	4	42	11	186
"	5	64°40' 22°43'	"	30 ¹ / ₅	2	308	14	11	629	100
"	6	64°11.5' 21°57.5'	"	31 ¹ / ₅	1	187	13	13	169	1
"	III	64°26' 23°12.5'	"	4 ¹ / ₉	4	6	4	5	166	184
"	IV	64°40' 22°38'	"	5 ¹ / ₉	2	450	1	8	54	—

¹ Station on the three miles limit. ² Selected samples only. Material from fine-mesh-net not included.

Table 8. Review of Research Trawlings carried out in Faxa Bay in the Various Months of the year by Different Vessels 1924—1945.

Year	Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1924	—	—	—	—	—	D	D	—	—	—	—	—
1925	—	—	—	—	—	E	D	D	—	—	—	—
1926	—	—	—	—	—	D	D	—	—	—	—	—
1927	—	—	T	T	—	—	D	—	—	T	—	—
1928	—	T	—	—	T	—	—	T	—	T	—	—
1929	—	T	—	—	T	—	T	—	—	T	—	—
1930	—	—	—	—	—	—	—	—	—	—	—	—
1931	—	—	—	—	—	—	D	—	—	—	—	—
1932	—	—	—	—	—	—	D	—	—	—	—	—
1933	—	—	—	—	—	—	—	D	—	—	—	—
1934	—	—	—	—	D	—	—	—	—	—	—	—
1935	—	—	—	—	—	—	—	G	G	—	—	—
1936	—	—	—	—	—	B, N	B, T	T	—	—	—	—
1937	—	—	—	—	N, T	—	—	—	—	T	—	—
1938	—	T	—	—	—	T	D	—	—	—	—	T
1939	—	—	T	—	T	—	D, G	—	—	—	—	—
1940	—	—	—	—	—	—	—	—	—	—	R	—
1945	—	Sk	—	—	Br	—	—	—	Br	—	Br	—

B = «George Bligh»; D = «Dana»¹; E = «Explorer»; N = «Nautilus»; T = «Thor».

Steamtrawlers: G = «Geir»; R = «Reykjaborg».

Motortrawlers: Sk = «Skálafell»; Br = «Bragi».

¹ 1938 and 1939 the new «Dana», motorship (the old «Dana» was a steamship).

Table 9. Marking Experiments carried out in Faxa Bay.

Cod	June	1909	— 200 specimens (30 recovered — vide SÆMUNDSSON 1913)
	May	1925	— 2 specimens
	Apr.—May	1935	— 524 specimens (104 recovered)
Haddock	June	1925	— (“Explorer”) 30 specimens (no results).
Plaice	June	1908	— 532 specimens (124 recovered — vide SÆMUNDSSON 1913)
	July	1909	— 200 specimens (118 recovered — “ ” “ ”)
	August	1925	— 250 specimens (47 recovered)
	July	1926	— 527 specimens (115 recovered).
	July	1927	— 462 specimens (92 recovered)
	July	1932	— 300 specimens (144 recovered)
	July	1938	— 300 specimens (123 recovered)
	Dec.	1938	— 18 specimens (1 recovered)
	April	1939	— 41 specimens (12 recovered)
Lemon Sole	June	1925	— (“Explorer”) 52 specimens (1 recovered)
Halibut	June	1925	— (“Explorer”) 103 specimens (8 recovered)
	July	1938	— 52 specimens (9 recovered)
Catfish	August	1933	— 5 specimens (2 recovered)
	May	1934	— 53 specimens (12 recovered)
Lump-sucker	April	1939	— 1 specimen (not recovered).

DESCRIPTION OF FAXA BAY

BY

BJARNI SÆMUNDSSON †

Of all the numerous bays and inlets that frame the outline of Iceland and determine its characteristic, dentated shape, Faxa Bay (Icel. Faxaflói) is one of the most prominent. From an ichthyo-biological and economic point of view it is a very interesting water and from the time of the first settlement it has played a very important part as food-store for the people living on its coasts or in neighbouring districts, and even farther away, for the people of the southern lowland, who used to take part in the winter-fisheries in the Bay, when the sea off their coasts was too rough for any extensive fishing.

In the following pages I shall try to sketch the main features of this Bay, the breeding place of many valuable food-fishes, having in view a possible and extensive protection of its stock of different species, which from early times down to the end of last century have made the Bay one of the best fishing grounds in Icelandic waters on account of their multitude.

1. Geographical position and size. From the inset on the Chart (Fig. 3) it will be seen, that the Faxa Bay is situated on the SW. coast of Iceland, between the large peninsulas of Reykjanes and Snæfellsnes, its geographical position being roughly speaking between 64° and $64^{\circ}45'$ N. L. and between $21^{\circ}50'$ and $23^{\circ}45'$ W. Gr. It is relatively short and broad, as the width of its mouth, between Gardskagi point on the Reykjanes peninsula and Malarrið on the Snæfellsnesside, is 48 miles (90 km.), while the distance from a line drawn between these points to the mouth of the inlet of Borgarfjörður (which will be the mean distance from this line to the mouth of the different inlets that penetrate deep into the coast from the main bay) is only about 26 miles (50 km.). Thus the area of the bay itself will be about 1,300 naut. square miles.

The coasts of the bay are on the whole very low; only the outermost parts of the two above-mentioned peninsulas rise to a height of 1—200 m., where the action of the waves has formed precipitous cliffs (Sölfahamar and Vogastapi), and here a great number of sea birds make their nests. Otherwise the coasts are flat, straightlined and sandy on the greater part of the Snæfellsnes, indented by several small or large inlets and lagoons that dry at low tides, as far as the east coast of the bay is concerned. The most prominent of the

inlets are the very shallow Borgarfjörður and the Hvalfjörður about 17 miles long, narrow and in some places pretty deep, whilst the broad and very shallow lagoonlike Hafursfjörður marks the NE. corner of the Bay (See Chart Fig. 3). — For sailing the coasts of the Bay are not convenient, as the broad opening allows the big ocean swell to approach them and in the winter to cause heavy surf during W. and SW. gales. Very dangerous is the open and sandy shore of Snæfellsnes, but especially so is the coast of the Myrar, the stretch of land between Hafursfjörður and Borgarfjörður, on account of the shallowness of the water and the countless visible and submarine rocks. More shelter and better conditions for sailing are afforded by the small inlets of the SE. corner of the Bay, the Kollafjörður, the Skerjafjörður and the Hafnarfjörður, where convenient and safe anchorplaces have given rise to the harbour of the old trading place Hafnarfjörður and the young capital. Several other trading and fishing stations are situated round the Bay: Búdir on Snæfellsnes, Borgarnes at Borgarfjörður, Akranes on the point of the north side of Hvalfjörður and Keflavík on the Stakksfjörður, the SW. corner of the Bay, between Gardskagi and Keilisnes.

2. Depth. (See Fig. 4). The geologists look upon the Faxa Bay, like its neighbour, the Breidafjörður (and the North Sea as well), as an area formerly dry land, now sunk beneath the level of the sea. Accordingly, the Bay on the whole is of very little depth. Omitting the southernmost part of the Bay, between Gardskagi and Hafnarfjörður, where the 20 m. depth curve is only half a mile or one mile from the coast, the coastal waters of the Bay are very shallow, especially along the NW. and N. coast, from the mouth of Borgarfjörður, to the mouth of the main Bay. In many places the 20 m. curve here recedes 2—3 or even more miles from the coast. This shallowness of the stretch of Bay mentioned is mostly due to the circumstance that some rivers — of which the muddy Hvítá is the most important — flow down each into its particular inlet or lagoon, carrying great quantities of muddy water (especially the Hvítá) and in the course of time fill them up, while some of the mud gets washed quite out into the Bay; here a N. and NW.-going current spreads it out in the NE. corner



Fig. 3. Faxa Bay. (Prepared by Dr. BJARNI SÆMUNDSSON) Ca. 1 300 naut. square miles inside the line Gardskagi—Malarri. (Fjords included).

Territorial limit (broken line).

The Bay is divided into three Areas:

South-eastern area (I), of which c. 160 n. sq. m. extraterritorially

Central area (II), " " c. 500 " " "

North-eastern area (III), " " c. 150 " " "

The extraterritorial Area is about 810 naut. sq. Miles.

of the Bay, where it sinks to the bottom and fills it up (THORODDSEN).

The remaining inlets S. of Akranes are deeper than the others and the relatively large Hvalfjörður in its inner part has two pits with depths of 60—80 m., while the depth at its mouth only reaches 40 m.

From the mostly very shallow coastal water of the Bay the bottom gradually deepens down to the 50 m. depth-curve, which on the northside of the mouth of the Bay approaches the coast as near as $\frac{1}{2}$ —1 mile only, and then after having run along the S. coast of the Snæfellsnes at a distance of 2—4 miles, takes a south-easterly, pretty un-

dulating course and approaches the mouth of the Kollafjörður at 3 miles only; here it turns back and taking a nearly opposite direction, bounds a 50—70 m. deep channel about 10 miles long, (the other part of which is the Akranesforir, to the Icelanders a well-known fishing ground). Finally, about 15 miles N. of the Gardskagi, the 50 m. depth-curve turns W. and S. and leaves the Bay 4 miles NNW. of the Gardskagi point, bounding on the SW.-side of the above-mentioned channel a large area with shallow water (in places only 10—20 m.; see above) in the southern part of the Bay. Glancing at Fig. 4, it will be seen that the area

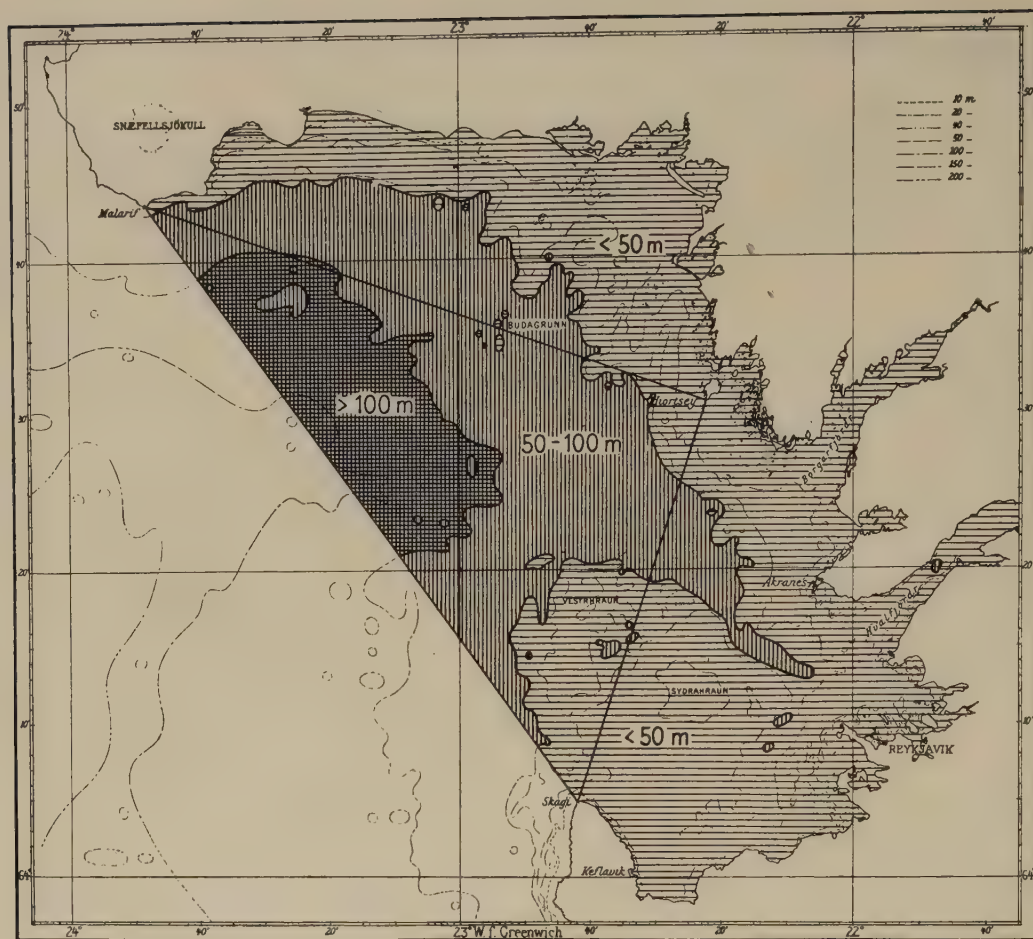


Fig. 4. Depth-Areas < 50 m., 50—100 m., > 100 m.

inside the 50 m. depth-curve (600 square miles) is nearly the half of the total area of the Bay.

From the 50 m. depth-curve the depth very gently increases down to the 100 m.-curve, leaving a 5—10 miles broad area, about two-fifths of the total area of the Bay, between the 100 m. and the 50 m. curve. The 100 m. depth-curve enters the Bay 5—6 miles SE. off Snæfellsnes (Malarí) and leaves it again near the middle of the mouth of the Bay, about 20 miles NNW. of Gardskagi, having roughly described a great rectangle about 25 miles long and 6—10 miles broad or about 200 square miles inside the limit. This area, which may be looked upon as the innermost end of the Jökuldjúp, has a depth down to 160 m. and makes about one-eighth of the total area of the Bay. In short: only $\frac{1}{8}$ of the area of the Bay is beyond the 100 m. depth-curve, nearly $\frac{2}{5}$ between the 100- and 50 m.-curve, and a little less than $\frac{1}{2}$ under 50 m.

3. The bottom (see Fig. 5) and its deposits. From the above bathymetrical sketch of the Bay it will be seen, that the greater part of its area is very shallow (in that respect the Bay is a miniature-replica of the North Sea). During SW.—NW. gales the water is stirred to the bottom and its mud-particles mixed together with those carried out into the Bay. This will be conspicuous especially during heavy rainfall and snow-melting in the winter and early spring, when the water in the Bay may be nearly as muddy as the water from the rivers themselves. Whilst these mud-particles, suspended as they are in the water, are for the greater part not allowed to sink to the bottom and form layers of mud and ooze in quiet places in the inner parts of the Bay, most of them will be washed down into the deeper tracts of the Bay itself by the action of the rather strong tidal and oceanic currents.

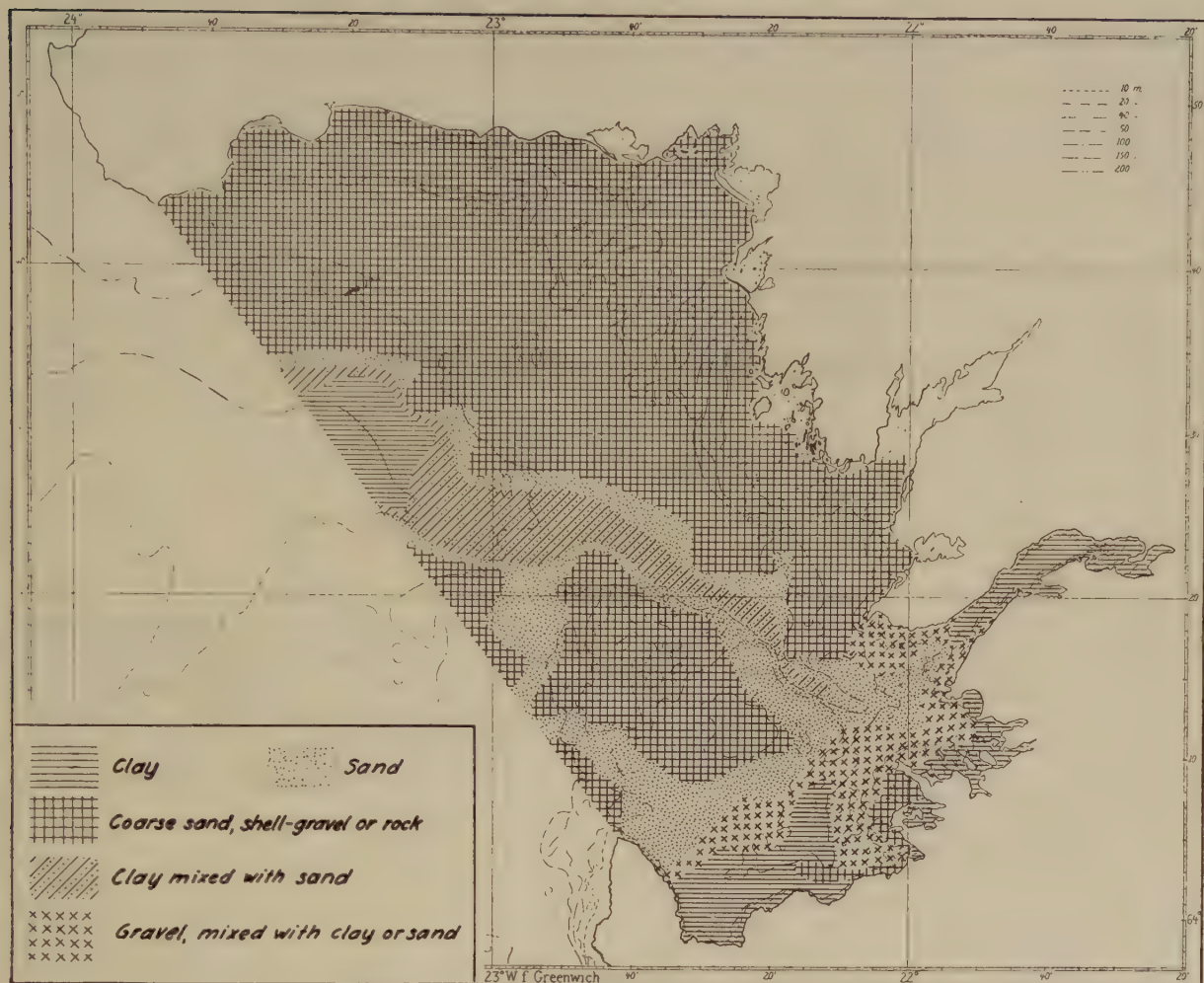


Fig. 5. The Nature of the Bottom of Faxa Bay.
(From HERMANN EINARSSON, 1941.)

From the above it will be seen that a mud- and ooze-bottom (Icel. "leir" and "ledja") is mostly to be found in the deeps of Hvalfjörður, in the deeper channels like Akranesforir and Strandarleir, inside the territorial limit and in the deepest tracts in the mouth of the Bay (Jökuldjúp). In the vast shallow area on both sides of the limit, the bottom as a rule is covered with black, volcanic sand or white shell-sand, made of the fragments of shells of different species of bivalves, crushed by shell-eating fishes, as the seawolf, haddock and plaice. In many places, especially on the above-

mentioned shallow "banks" or grounds outside the limit, the Sydra-Hraun and Vestra-Hraun (Hraun means lava, but is not a true lava, built up as it is of tufa strata), the hard rock probably constitutes the foundation under the looser bottom layers; these have in the course of time filled up the lower tracts of the bottom with shell-sand washed down from the higher (shallower) tracts, whilst the rocks now jut out of the looser layers and on account of their roughness, eaten as they are by boring shells, often make trawling difficult or impossible.

THE HYDROGRAPHICAL CONDITIONS IN FAXA BAY

BY

HELGE THOMSEN

Currents.

The currents observed round the coasts of Iceland may be regarded as the resultant of two different currents, namely, the tidal current and the residual current. As a rule the former is the strongest, but as it changes in direction and strength periodically with the tides, it causes on the whole only a periodic shifting of the water-masses.

The residual current, on the other hand, causes a movement of water along the coasts of Iceland in the same direction as the hands of a watch. Thus it brings water-masses from the south coast of Iceland round Reykjanes, into Faxa Bay and farther to the north. The residual current is influenced to a considerable extent by the wind conditions, and does not show a constant rate of flow; for short periods it may even be changed in direction. Nevertheless, over long periods the above-noted direction will be the dominant one and the mean rate of flow, according to current bottle experiments, may be estimated at about 6 naut. miles in 24 hours.

Temperature.

The south coast of Iceland is washed by relatively warm Atlantic water, and since the shelf is fairly narrow and no promontories or fjords prevent a free exchange of water, we find in the main the same conditions of temperature over the shelf as in the waters outside. In Faxa Bay the exchange with Atlantic water is considerably less and we thus find here that the temperature follows a somewhat different course throughout the year.

To illustrate the temperature conditions in Faxa Bay, contrasted with other places, the accompanying Table 10 gives data indicating the mean monthly

temperatures of the surface water at different places on the coasts of Iceland. The mean temperatures have been calculated from daily observations during the years 1924—1933 collected by the Icelandic Meteorological Institute.

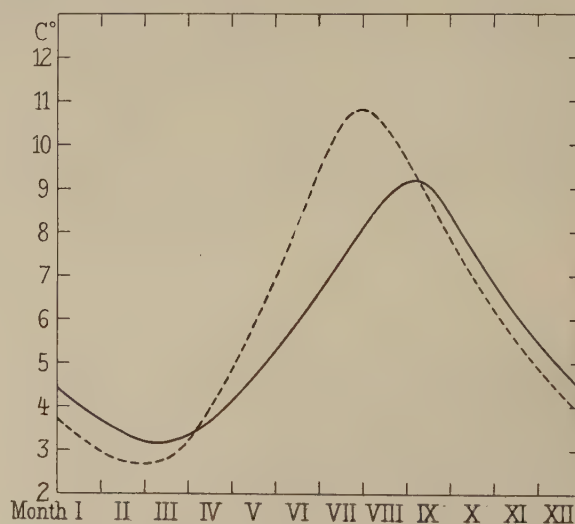


Fig. 6. Variation of Temperature during the year in Faxa Bay (off Akranes).
----- Surface ——— 50 metres Depth.

Salinity.

The Atlantic water, which sweeps up against the south coast of Iceland, has a salinity of slightly over 35 ‰. Close to the coast it mixes with fresh

water from the rivers, thus forming the so-called coastal water. This consequently has a lower salinity than the Atlantic water and forms a belt of varying extent and depth round Iceland. Over the Selvog Bank the coastal water extends on an average about 22 naut. miles from the coast. Its depth may be put to 50 m. nearest the coast, decreasing outwards.

In Faxa Bay the surface water consists of coastal water with a salinity between 34 ‰ and 35 ‰. The bottom layer likewise consists of coastal water, but with a salinity that lies as a rule between 34.5 ‰ and 35 ‰; nevertheless, Atlantic water with salinity greater than 35 ‰ may penetrate into the Bay, right to the 25 m. contour, especially in the summer months.

Table 10. Mean Monthly Surface Temperatures.

Month	Vestmannaeyjar S. Iceland	Grindavik S. W. Iceland	Reykjavik Faxa Bay	Stykkisholmur Brede Bay	Grimsey N. Iceland	Papey E. Iceland
I.....	6.0	4.6	1.8	1.2	2.5	2.2
II.....	5.9	5.0	2.0	1.2	2.2	1.9
III.....	6.3	5.4	2.6	1.5	2.2	1.8
IV.....	7.0	6.3	4.0	3.0	3.0	2.6
V.....	8.4	8.2	6.9	5.8	4.6	4.1
VI.....	9.6	9.8	10.1	8.7	6.6	6.1
VII.....	10.9	11.1	11.8	10.8	8.3	7.6
VIII.....	11.2	11.1	11.8	10.9	8.9	8.1
IX.....	10.0	9.8	10.0	9.4	7.5	7.4
X.....	7.8	7.5	7.0	6.5	5.9	5.6
XI.....	6.6	5.9	4.4	3.8	4.5	4.0
XII.....	6.3	5.4	3.2	2.7	3.1	2.8
Yearly mean....	8.0	7.5	6.3	5.5	4.9	4.5
Max.—Min.	5.3	6.5	10.0	9.7	6.7	6.3

The variation of the temperature throughout the year in the deep water of Faxa Bay is shown in Table 11 below, which gives the mean monthly

temperatures at different depths off Akranes, 64°14'5 N., 22°13' W.

Table 11. Variation of Temperature in Faxa Bay throughout the year.

m.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
0.....	2.2	3.5	3.5	4.7	6.6	10.0	11.1	11.6	10.1	7.2	4.7	?
10.....	2.3	3.5	3.5	4.5	6.3	9.2	10.4	11.4	10.1	7.5	4.9	?
25.....	2.4	3.6	3.7	4.6	6.0	7.9	8.9	10.0	10.0	7.6	5.7	?
50.....	2.8	3.9	3.8	4.7	5.7	7.2	7.8	8.9	9.5	8.0	6.0	?

BOTTOM INVESTIGATIONS

BY

R. SPÄRCK¹

In the course of the years some 100 bottom samples have been taken with Petersen's $\frac{1}{5}$ m². grab, and since these samples present a fairly correct view of the amount and distribution of fish food in its main features we feel justified in drawing the following conclusions (for further details see R. SPÄRCK 1929, 1936 and 1937).

The fish food in Faxa Bay belongs to three animal communities, i. e., one that is confined to the clay bottom of the southern part of the Bay, particularly between Keflavik and Reykjavik and the adjacent fjords, another one to the sandy bottom of the central parts of the Bay and the last one to stone and gravel bottom, particularly off Akranes, Utskalar, Sydra Hraun and other banks in the Bay. The first community, the *Macoma calcaria* community, contains as a rule a very considerable amount per m². of living animals, on an average 210 g. which, in certain places of the southern part of the Bay, may rise to more than 1,000 g. per m². It is made up of animals that can be characterized as excellent food for bottom fish, especially plaice and haddock, since far beyond 90 % of the animals of this community are Lamelli-branches, in the first place *Macoma calcaria*, and besides various polychaetes, *Nephtys* species and others. In Faxa Bay this community occurs chiefly

in territorial waters, and there is all reason to believe that it must be of great importance for the production of bottom fish in the Bay, equalling,

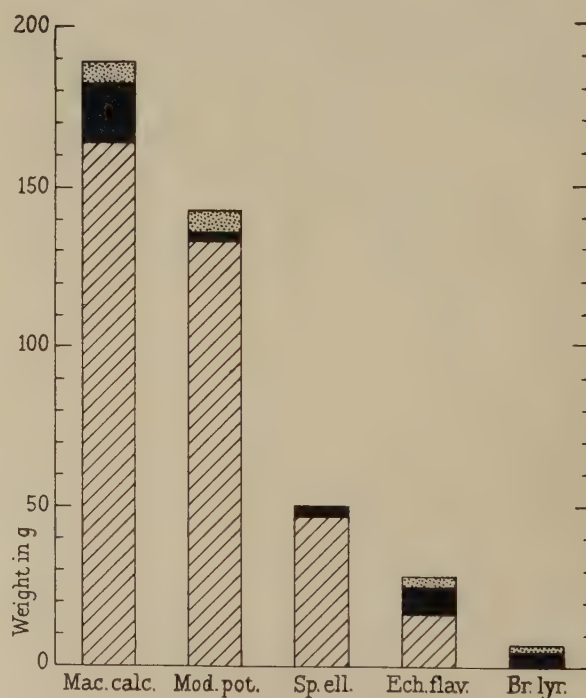


Fig. 7. Graph showing the Quantitative Composition of the Benthonic Animal Communities of Faxa Bay.

Oblique hatching = Lamellibranchs, black = Echinoderms, dotted = Polychaets. Average weight in grammes per 0.2 m². Mac. calc. = *Macoma calcaria* community; Mod. pot. = *Modiola-Potamilla epifauna*; Sp. ell. = *Spisula elliptica* community; Ech. flav. = *Echinocardium flavescens* community; Br. lyr. = *Brissopsis lyrifera* community. (Redrawn from HERMANN EINARSSON 1941, Fig. 7, p. 27).

¹ Since the present paper was issued two papers have appeared on the subject:

- 1) R. SPÄRCK: The Benthonic Animal Communities of the Coastal Waters. The Zoology of Iceland I; 6. 1937.
- 2) HERMANN EINARSSON: Survey of the Benthonic Animal Communities of Faxa Bay (Iceland). Medd. Komm. Danm. Fiskeri- og Havunders., Fiskeri XI, 1. 1941.

For further details it is sufficient here to refer to these works.



Fig. 8. Distribution of the Benthonic Animal Communities in Faxe Bay.

Mac. calc. = *Macoma calcarea* community; Mod. pot. = *Modiola-Potamilla* epifauna; "r" Sp. ell. = "rich" *Spisula elliptica* community; "p" Sp. ell. & Mod. mod. = "poor" *Spisula elliptica* community and *Modiola* epifauna; Ech. flav. = *Echinocardium flavescens* community; Br. lyr. = *Brissopsis lyrifera* community. (From HERMANN EINARSSON, 1941, Fig. 6, p. 11.)

as it does, both in amount as in composition, the best communities in north-European waters. This community occurs exclusively in rather low water and has never been ascertained in depths exceeding 40 m.

In mostly extraterritorial waters in the central parts of the Bay, on sandy bottom and occasionally in somewhat greater depths, there is a *Spisula elliptica* community, likewise chiefly characterized by small Lamellibranches (*Spisula elliptica*, *Syn-dosmya prismatica* and others), polychaetes and further by the fish *Ammodytes lancea* — all constituting good food for plaice and haddock, the last-named for cod also. The average weight per m². of

living animals in this community is very high, 420 g. per m²., in some samples rising to 11—1200 g., and consequently it does not fall much short of the corresponding *Spisula subtruncata* community in the North Sea. An essential part in the importance of Faxe Bay as fishing ground can thus be ascribed also to this community.

The third community, the *Modiola modiola* epifauna, contains likewise numerous good food animals, especially for cod (*Galathea nexa*, various polychaetes), and even though its distribution in Faxe Bay is not quite so well known, it must be an important factor for the abundance of fish in these waters.

SURVEY OF THE FISH FAUNA

BY

BJARNI SÆMUNDSSON †

In accordance with its geographical position, the depths and physical conditions of the Bay are merely a continuation of those in the sea off the SW. coast of the island, or the boreal part of the N. Atlantic. Conjoined with the bottom conditions this has a great influence on the life in the Bay as a whole, making it much richer and more varied than if the depth were very great, with low temperature and darkness in the deeper layers of the water. For the life of the fishes this is of a great importance, as the bay at the same time is a vast spawning area for many species, with pelagic and demersal eggs, a very good nursery for many fish during the first two-three years and a rich food-store for many different species of fish at a more advanced age. In short, the bay is of great importance as spawning place, nursery and hunting ground for an enormous number of fish of different kinds, both inside and outside the territorial limit, and millions of these fish have yearly been caught by native and foreign fishermen over a long period.

Of the ca. 138 species of fish at present known in the waters round Iceland inside (down to) the 400 m. depth-curve,¹ 64 are with certainty found in Faxa Bay, and 10 so near to its boundary that they might occasionally be found inside the limit. Of the 74 species of fish one may thus meet in the Bay, ca. 14 are stragglers (summer visitors) from the Atlantic, most of them met with very rarely — one or few specimens only. Of the true residents of the Bay the majority belong to the boreal and some few to the boreo-arctic or arctic fauna. Of one species (*Phycis borealis* B. Sæm.), doubtless a deep-water form from the slopes of the continental shelf off SW-Iceland, 6 grown-up specimens were found in the outer part of the Bay and its neighbourhood but nowhere else. Of the ca. 50 resident species, nearly two fifths are of no economic value, being either too few in number, too small or uneatable; two (the lesser sandeel and the capelin)

are of great value as food for other fish. Only the remaining ca. 29 species are of more or less importance as food-fishes for man.

Among those remaining 29 species we find 4 "freshwater" forms, which can be totally disregarded as subjects of marine fishing in the Bay; they are: salmon (*Salmo salar* L.), sea-trout (*Salmo trutta* L.), char (*Salmo alpinus* L.) and eel (*Anguilla vulgaris* Turt.). 7 other species, viz.: starry ray (*Raja radiata* Don.), shagrin ray (*Raja fullonica* L.), Greenland shark (*Somniosus microcephalus* Schn.), basking shark (*Selache maxima* [Gunn.]), picked dogfish (*Squalus acanthias* L.), porbeagle (*Lamna cornubica* Gmel.) and long-rough dab (*Drepanopsetta platessoides* [O. Fabr.]) are of very little importance. Finally we have to deal with 18 specimens, all valuable, some of fundamental importance for the fisheries as well in Faxa Bay as elsewhere in the Icelandic area. They are: Norway haddock (*Sebastes marinus* [L.]), angler (*Lophius piscatorius* L.), whiting (*Gadus merlangus* L.), dab (*Pleuronectes limanda* L.), witch (*Pleuronectes cynoglossus* L.), megrim (*Zeugopterus megastoma* Don.), lemon sole (*Pleuronectes microcephalus* Don.), catfish (*Anarrhichas lupus* L.), lump-sucker (*Cyclopterus lumpus* L.), torsk (*Brosimius brosme* [Asc.]), common ling (*Molva vulgaris* Flem.), skate (*Raja batis* L.), coalfish (*Gadus virens* L.), halibut (*Hippoglossus vulgaris* Flem.), plaice (*Pleuronectes platessa* L.), haddock (*Gadus aeglefinus* L.), herring (*Clupea harengus* L.) and cod (*Gadus callarias* L.).

Of these 15 fishes the lump-sucker is of interest as the fish of the Laminaria-zone, well liked as food and often caught in great numbers by the Icelanders, but not exported. Of all the others the cod and haddock have from the first been by far the most valuable for the Icelanders, being their principal foodfishes and the cod the main article of export. The herring and the flatfishes were hardly recognized as valuable 50 years ago, the other sea-fishes proper were only casually caught together with cod and haddock, and with the same gear (handline, longline with small hooks, or gill-nets).

¹ Vide the author's paper: Synopsis of the Fishes of Iceland. 1927.

In the description of the Bay I emphasized its shallowness in connection with the bottom-conditions as a factor of great importance for the development of a rich invertebrate fauna, which in its turn forms the basis for its rich fish-fauna. Very essential is the microplankton that grows up and fills the Bay in the spring and summer and facilitates the spawning and first growth of the fish brood of different kinds. Towards the winter it disappears and most of the pelagic fish-brood have settled on the bottom. Partially this fauna is a neritic one, composed of many different animals, sedentary on hard bottom, burrowers, like different bivalves and polychaets, on the loose bottom; the following constitute a very important part of the food of flatfish, haddock and catfish: *Macoma calcaria* and *Nephtys ciliata* on muddy bottom, *Spisula elliptica* on sandy bottom and 30—40 m. depth, *Mytilus edulis* in very shallow water (3—5), *Cyprina islandica* on both. To this several species of small crustaceans, e. g., *Crangon allmani*, *Eupagurus* and *Hyas* may be added, as food for codling, young coalfish and other small fish.

Many of the fish that feed on this kind of non-migrating animals will be stationary all the year round in the Bay, while the migrating ones will leave the inner parts of the Bay at the end of the year, specially the plaice, young cod and other fish, that move out to open sea for spawning. The lesser sandeel and some yearlings of the herring will often stay (but irregularly) in the Bay through the winter and serve as food for several of the fishes mentioned, but save for that the winter is a relatively poor season for fishing, as the majority of grown-up and a great number of young fish have left the Bay.

In the early spring, when the temperature of the water rises, and the *Calanidae* fill the sea, the lesser sandeel in its chase for food comes gradually in great swarms into the Bay, occupying all areas with sandy bottom (e. g. the above mentioned extraterritorial grounds of the southern part of the Bay), where it can easily dive into the sand and thus escape its enemies. In the course of the summer the numbers of this little fish increase rapidly, and it becomes by far the most important food for nearly all the most valuable of the fishes of the Bay (e. g., cod, haddock, young halibut, plaice), which pursue it from the grounds outside the Bay and gorge on it until the close of the year.

And I do not hesitate to state that Faxa Bay has in the first instance to thank the lesser sandeel for its rich fishing grounds.

Another fish of great importance as food for valuable fish is the capelin. This little fish appears towards the spring-equinoxes in most years, for spawning purposes. Migrating along the coast, following the Gulfstream round the Reykjanes peninsula and then crossing the mouth of the Bay, it makes its way to the NW.-coast, or turning round the Gardskagi point enters the Bay, usually some time in April. This little fish is the favourite food of the cod, which gorges on it until the walls of its stomach become quite a thin and transparent film. If the capelin enters the Bay, it will be persecuted by great shoals of cod from the grounds outside the Bay. It disappears again, as a rule, in the latter half of May or sometimes in June. — The third small and very numerous fish, the Norway pout, which is very important as food for cod and ling on the deeper grounds off the S. and W. coast, hardly enters the shallow Bay.

From the above it will be seen, that there is a continual inflow of different, valuable fish into the Bay, from about the middle of March to the end of the autumn. The lump-sucker and the capelin come for the spawning's sake only, the mature cod and the mature herring for feeding and for spawning as well. The Icelandic herring consists of two different races: a spring-spawner and a summer-spawner. Both races visit the Bay at the end of April and later, in search of food (*Euphausiidae* and *Calanidae*), but the first-named has already spawned before entering the Bay, the second one does so in July—August. The immature cod, the immature herring and some other valuable fish, as plaice, halibut, coalfish and haddock, visit the Bay only for the food's sake. Thus it will be clear, that a constant coming and going of shoals of different valuable fish takes place from the early spring to the end of the autumn.

When migrating into the Bay, the fish seem to follow the deeper channels as "highways" from the open ocean into the Bay, the Jökuldjúp and the Gardsjór (see the chart), and spread themselves over the adjacent above-named grounds outside and inside the limit. But the quantities of the different fish are very variable from one year to another, which again has a very great influence on the results of the fisheries.

THE HALIBUT IN FAXA BAY

BY

P. JESPERSEN

The Halibut Fishery at Iceland. In the years before the war, 1906—13, the annual output of the halibut fishery in Icelandic waters showed considerable variation, but with a steadily decreasing tendency. In 1907 there was a maximum of 7,920,000 kg., then a fairly uniform decrease till 1913, when only 4,252,000 kg. were fished. During the war 1914—18 only small quantities of halibut were taken, but in the years immediately after the war there was a sharp rise, culminating in a maximum in 1923, when altogether 7,009,000 kg. were caught in Icelandic waters.¹ From 1924 to 1938 we see again a heavy fall in the output of the halibut fishery. Dividing this period into 4-year groups we find the average output to be as follows:

1924—1927	1928—1931	1932—1935	1936—1938
5 855 tons	3 045 tons	2 975 tons	2 701 tons

which shows that in the last two periods only about half the quantities were taken as in the period 1924—27.

In spite of the considerable decline in the halibut fishery in the waters round Iceland, it still constitutes a respectable proportion of the total halibut fisheries in the North Atlantic. According to the "Bulletin Statistique" for 1935 the total halibut fishery amounted to 12,774,000 kg., the fishery at Iceland contributing about 22.1 %, thus about 2,818,000 kg. The value of the total halibut fishery at Iceland for that year was about 3,400,000 shillings. For 1938 the total fishery amounted to 9,992,000 kg., 26.3 % or 2,629,000 kg. from the Icelandic area.

Biology of the Halibut. According to the results of investigations the halibut migrates out to great depths for the purpose of spawning, its eggs being found in depths between 200—700 m. over depths of about 1,100—2,000 m., in the waters between Iceland and Scotland. The spawning time in the North Atlantic occurs in all probability in spring, in the months March to May with April as the

principal period. The post-larval stages, which live pelagically, are carried by the Atlantic current to the south, west and north coasts of Iceland, some part also with the west-going branch of the Irminger Current out into the Denmark Strait and over towards East Greenland. The oldest post-larval stages as well as the youngest bottom stages are mainly found over shallower waters, and along the coasts of Iceland Faxe Bay must undoubtedly be regarded as one of the principal nursery grounds for the quite young halibut, since we find there a considerable stock of these, especially inside the 50 m. line. As will be seen below, the earliest year-groups (I—III) constitute by far the greater part of the halibut stock in the Faxe Bay area.

Importance of Faxe Bay as a Nursery for young Halibut. The trawling experiments in Faxe Bay during the years 1924—35 yielded a material of in all 3,677 specimens of halibut, by far the great majority being of the younger year-groups. Table 12 indicates the numbers of the respective age-groups for the territorial and extraterritorial waters respectively, and also the two areas under one.¹

Table 12.

Age-group	Territorial waters		Extraterritorial waters		Total	
	No.	%	No.	%	No.	%
I	210	10.3	185	11.3	395	10.7
II	959	47.2	866	52.7	1825	49.7
III	725	35.7	508	30.9	1233	33.5
IV	125	6.1	81	4.9	206	5.6
V + ...	14	0.7	4	0.2	18	0.5

As will be seen from Table 12, the age-composition is practically the same in both territorial and extraterritorial waters, the two groups II and III being most prominent in both areas. Halibut of these two age-groups, which together constitute 83.2 % of the total number of halibut, have in Faxe Bay an average length of respectively ca. 25 and ca. 35 cm., and an average weight of respectively ca. 150 and ca. 450 g. The age-group IV

¹ The annual yields for the period 1906—1938 are given in Table 45, paper No. 16.

¹ For further information see STRUBBERG, Paper 20, p. 94.

Table 13. Average Numbers per trawling hour according to years.

	1908	1924	1925	1926	1927	1928	1929	1931	1932	1933	1934	1938	1939
No. of halibut . . .	534	1,193	198	252	856	310	337	346	240	121	48	157	640
No. of trawling hours	29.5	83.75	39	63	65	80	76	40	48	22	12.83	20	14
Average No. of halibut per trawling hour	18.1	14.2	5.1	4.0	13.2	3.9	4.4	8.6	5.0	5.5	3.7	7.9	45.7

only contributes 5.6 % to the total number of halibut and specimens of age-group V and older groups only amount to 0.5 % of the total halibut stock. The average length for age-group IV lies about 45—50 cm. Hence we find, that the 4 youngest age-groups contribute no less than ca. 99.5 % of the halibut stock in Faxe Bay and of the total number of specimens taken, 3,677, only 86 were larger than 50 cm., which means that ca. 97.7 % of the halibut stock are smaller than 50 cm.

In further illustration of the part played by the young halibut in the practical trawl-fishing of Faxe Bay, it may be mentioned that the English fisheries statistics for the years 1932—36 show, that the first-class steam-trawlers have taken the following relative quantities of the three market categories of halibut in the Faxe Bay area:

Large: 9.7 % Medium: 9.4 % Small: 80.9 %

It appears from these figures, that the small sizes of halibut contribute by far the largest proportion to the output of the trawl-fishing in Faxe Bay.

Fluctuations in the Size of the Halibut Stock in Faxe Bay in different years. Calculating the average numbers of halibut fished per trawling hour in the different years, we obtain an impression of the relative quantities of the stock. Systematic trawling with a 50-foot otter-trawl has been carried out in Faxe Bay in the following years: 1908, 1924—29, 1931—34 and 1938—39. The averages per trawling hour in the respective years are shown in Table 13.

It appears from the above that in the different years rather considerable fluctuations have taken place in the number of halibut per trawling hour. In 1908 the number was thus about 18 specimens and in 1924 about 14 specimens. In the years 1924—29, with the exception of 1927, a noticeable decrease, from about 14 to 4—5 specimens, could be traced. A somewhat similar decrease is also seen in the years 1931—34 when the number decreases from 8—9 to 3—4 specimens per trawling hour. In 1938 the number is about 8 specimens, and then in 1939 it rises to 45—46 specimens. The latter year must be considered as being quite exceptional, as during the other 12 years of investigation no quantities of young halibut approaching the number of 1939 were found in Faxe Bay.

When comparing the catch from 1908 with the average numbers of the periods 1924—29, 1931—34 and 1938—39 we get the following number of specimens per trawling hour: —

1908	1924—1929	1931—1934	1938—1939
18.1	7.5	5.7	26.8

The large average number of the latter period is especially due to the unusually large quantities found in 1939. Possibly, the exceptionally large quantity in 1939 may be explained solely by the fact that the year-classes 1937 and 1938 were remarkably good, but the possibility cannot be disregarded that the large stock of young halibut in Faxe Bay in the summer 1939 may be due to special hydrographic conditions, as, in the years concerned, there was an extraordinarily strong inflow of Atlantic water into Faxe Bay which may have caused remarkably large quantities of young halibut to be carried into that area. In all probability, however, the conditions in 1939 must be considered as extraordinary, whether due to an unusually vigorous production in the preceding year-classes (1937 and 1938) or, merely, because, the exceptional hydrographic conditions caused a remarkably large accumulation of fry. Excluding the year 1939, a comparison with the other years of investigation will clearly show that, on the whole, a considerable decrease in the quantity of young halibut has taken place in Faxe Bay.

With regard to the relative quantities of halibut in territorial and extraterritorial waters in Faxe Bay certain changes seem to have taken place during the years. In the periods 1924—29, 1931—34 and 1938—39 the average number of halibut per trawling hour inside and outside the territorial limit in Faxe Bay is as follows:

	1924—1929	1931—1934	1938—1939
Territorial waters:	9.7	4.3	30.9
Extraterr. waters	5.5	7.2	22.7

As will be seen, the comparatively largest quantities have been caught in territorial waters in the periods 1924—29 and 1938—39, while in 1931—34 the largest quantities were taken outside the territory, on which, however, a very active Danish seine fishery then took place.

Nevertheless it is certain, that it has been especially the intensive trawl-fishing which has reduced the halibut stock in the Faxe Bay area during the years 1908—34, large quantities of quite young specimens being destroyed by this fishery. The vitality of the small halibut in the trawl and after coming on deck is relatively low. Experiments have shown, that halibut caught in the trawl had much less power of resistance than various other species, e. g., cod and plaice. The maximum duration of life for small halibut after coming on deck was found to be about 30 minutes.

Table 14. Average Numbers per trawling hour — according to districts.

	1924—1929				1931—1934				1938—1939			
	Iceland				Iceland				Iceland			
	Faxa Bay	N.	E.	S.	Faxa Bay	N.	E.	S.	Faxa Bay	N.	E.	S.
No. of Halibut.....	2,807	34	1	75	772	5	12	12	797	0	1	—
No. of trawling hours.....	268.3	42.3	7	29.5	124.8	2	13	7.5	34.5	3.3	3.5	0
Average No. of Halibut per trawling hour.....	10.5	0.8	0.1	2.5	6.2	2.5	0.9	1.6	23.1	0	0.3	—

Size of the Halibut Stock in Faxa Bay by Comparison with other Icelandic Waters. During the periods 1924—27 and 1931—34 trawling experiments were carried out in various Icelandic waters with a 50-foot ottertrawl from the research vessel "Dana"; from the material collected it is possible to get an impression of the size of the halibut stock in the different areas, taking the average numbers of halibut caught per trawling hour. Since, as noted above, a decrease in the stock of halibut is noticeable in Faxa Bay since 1924, we may separate the material into three periods, namely 1924—29, 1931—34 and 1938—39, and thus obtain the average quantities per trawling hour in Faxa Bay (see Table 14), on the north coast, east coast and south coast of Iceland respectively. With regard to the material used it should be remarked that only hauls made in depths of less than ca. 50 m. have been included.

The number of trawling hours for Faxa Bay is admittedly much larger than for the other coasts round Iceland, but the averages per trawling hour show clearly, nevertheless, that the halibut stock is much greater in Faxa Bay than at other places round Iceland. Taking the whole material for the periods 1924—27, 1931—34 and 1938—39 together, we obtain the following average numbers of specimens per trawling hour: —

Faxa Bay	N. Iceland	E. Iceland	S. Iceland
10.2	0.8	0.6	2.4

To judge from these figures, the stock of small halibut in Faxa Bay is 3—4 times larger than on the south coast, 11—12 times larger than on the north coast and 13 times larger than on the east coast.

THE PLAICE IN FAXA BAY

BY

Å. VEDEL TÅNING

I. Remarks on the Plaice Fishery at Iceland and in Faxe Bay

Right from the time when the earliest English trawlers, about 1894, made their first trials here,¹ the southern part of Faxe Bay has been one of the principal areas for the plaice fishery at Iceland. The importance of the Bay for the whole plaice fishery at Iceland has varied a good deal, but even in 1934, when England landed 3,587 tons of plaice, out of a total of 4,670 tons (value ca. 4½ million shillings) fished at Iceland, about 8 % of the quantity was taken in Faxe Bay;² in the years 1932—35 between 8 and 11.5 % of the English catch of plaice at Iceland came from the Bay. In the first score of years the trawl fishery has certainly taken much larger quantities than at the present time in the Bay itself, but one should note, that as other good trawling grounds were gradually found and the methods used altered to suit the more difficult bottom-conditions elsewhere round the island, the importance of the Bay declined somewhat; to this also we must add the increasing plaice-seine fishery in the Bay of recent years as contributory cause.

No information is available regarding the output of the plaice fishery in Faxe Bay itself during the last 30 years approximately; but a general survey of the whole plaice fishery at Iceland (see Paper 16, Table 46), indicates also for Faxe Bay some of the main features in the history of this fishery. The Icelandic fishery constitutes but a small part of the total plaice fishery of north-west Europe, in the years 1932—34 between 5.6 and 8 %; of this amount probably only about one-tenth came from Faxe Bay. The English fishery has always been the most prominent, though Scotland and Germany have periodically fished a considerable amount;

¹ The first trawlings at Iceland were made in the summer of 1891, among other places at Ingolfshöfði.

² In the English statistics, however, Faxe Bay is not altogether delimited as in the accompanying charts of this survey.

during the nineties and in the beginning of this century a certain amount of fishing for plaice was carried on in the fjords by Danish fishermen and in the last years Denmark has again taken up the plaice fishery at Iceland (with the Danish seine). Other nations have always shared to but an inconsiderable extent in the plaice fishery of Iceland. In Faxe Bay itself it is now almost exclusively England and Iceland which carry on the plaice fishery; both these countries fish in extraterritorial waters. Within the territorial waters of Faxe Bay (and Breida Bay) the Danish-seine fishery is only permitted to vessels registered in the adjacent districts (Statute No. 52 of 19/6 1933) and fishing with the Danish seine in the Bay may only be prosecuted during the period from 15th May to 30th November (according to Statute No. 45 of 13/6 1937). The quantities of plaice taken in Faxe Bay by other gears than trawl and Danish seine are inconsiderable.

The output of the plaice fishery at Iceland per fishing unit has very greatly decreased in recent years. The average catch (in cwts.) per 100 hours trawling of British steam-trawlers has fallen to less than half in the course of the last 10—15 years, as shown in the following summary:—

1922—1924	49	cwts. per 100 hours trawling ¹
1925—1928	41	» » » » »
1929—1932	31	» » » » »
1933—1936	21	» » » » »
1937—1938	18.5	» » » » »

At the same time an obvious change has taken place in the composition of the catches, as is clearly shown by the following summary of

¹ For the sake of comparison it may be mentioned, that the average catch per 100 hours trawling in the North Sea was 15 cwts. in the period 1922—1929 and 17 cwts. in the period 1930—1936.

the yield of British steam-trawlers in 1,000 cwts. of the three main market categories in Icelandic waters. Even if the limits of the different categories have changed somewhat in the course of the years, there can be no doubt as to the change on the whole in the composition of the stock; the large fish have very greatly decreased whilst the small fish have relatively increased.

Period	Average in 4-yearly periods (1000 cwts.)			
	Large	Medium	Small	Total
1906—1909	78.5	63.8	3.5	146
1910—1913	36.0	60.8	6.0	103
1914—1920	—	—	—	—
1921—1924	17.0	67.8	10.5	95
1925—1928	13.0	65.5	28.8	107
1929—1932	10.0	63.8	34.0	108
1933—1936	6.5	41.3	24.3	72
1937—1938	5.0	37.5	19.1	62

II. The Life-History of the Plaice in Faxa Bay

Various works have contributed to clear up a number of the questions dealing with the life-history of the plaice at Iceland, and several of them are concerned with Faxa Bay (SÆMUNDSSON 1913 and 1916, TÅNING 1926, 1929, FRIDRIKSSON 1932). Referring to these works for details, a brief survey of the conditions in Faxa Bay may be given here.

The Plaice spawns apparently not at all or only to a small extent in the inner parts of the Faxa Bay; it is only out in the deeper parts towards the Reykjanes peninsula and off Snæfellsnes that spawning takes place, but no delimitation of these spawning places has yet been made. It seems certain, however, that no important spawning ground is to be found in the inner parts of the Bay and the eggs and tiny fry, which are found in the Bay in the spring months, seem mainly to come from outside, for the greater part most probably from SW. Iceland, where spawning is at its height in April. In all bays, fjords and inlets with suitable bottom-conditions the 0-g r o u p specimens are met with in fairly large quantities from about 1st July; the growth is less than on the south coast, presumably owing to the lower temperatures prevailing in Faxa Bay for a great part of the year. As time goes on, migration takes place towards the more open parts of the Bay, where the majority of the plaice live until the mature condition sets in. A distinct seasonal wandering can be noticed, however, i.e., an emigration towards deeper water in the cold period and immigration into shallower waters in the warm period. The plaice in Faxa Bay seem in the main to reach their first maturity at a length of ca. 40 cm. or more; thus it is very rare to meet with ripe specimens down to about 30 cm. in length and only 5 years of age. The emigration out of the Bay

These changes in the whole plaice fishery at Iceland have naturally also occurred in Faxa Bay itself, even if we cannot prove this owing to the lack of the necessary data for a long period. The trawling experiments of the "Dana", "Thor" and other research-vessels from 1924 up to the present throw light on the conditions, however, as will be seen from several of the tables appended to the last part of this paper.

The minimum size for plaice landed in England is 23 cm., and Iceland has introduced a minimum for plaice of 27 cm. Since plaice of less than ca. 20—25 cm. could formerly be taken only in very small quantities with the trawl in extra-territorial waters, the minimum size has only come to be of importance with the increasing territorial fishery. The size of mesh in the Danish seine is now 120 mm. in Iceland; and most plaice below 25 cm. escape through this mesh.

to the spawning grounds at its mouth, as also north and south from there, takes place at an age of 6—7 years. Some of the spent individuals return later to the Bay in summer and then one may find a few old, large specimens among the numerous juvenile stages. (Information regarding the composition of the catches in and outside the Bay is given by TÅNING 1929 p. 55 et seq.). A more precise investigation of the size, age and migrations of the plaice in this area when approaching maturity is desirable. The investigations made in the years 1924—27 showed, that plaice of the territorial area on the south side of the Bay were on an average a couple of cm. smaller than plaice of the same age from the extraterritorial, strongly fished areas (see Table 19); the reason for this may be found partly, in the different densities of the stock partly, in a difference in the food conditions inside and outside the territorial limit,¹ and possibly also in the fact, that the largest individuals travel out sooner into the more open areas of the Bay.

The growth of the plaice in the Bay during the period investigated was slower than in the western half of the south coast, which shows the greatest growth for Iceland, undoubtedly due to a great extent to the higher temperatures at this part of the island. Various changes in the composition of the stock have occurred in recent years, as will be discussed below.

The density of the Plaice population in Faxa Bay (apart from the shore zone and small scattered areas, e. g. in the northern part of the Bay) is greatest in the southern parts of the Bay, where large tracts are covered with mud, sand mixed with mud or sand with a rich bottom-fauna. The catch

¹ The length-weight coefficient has been found to be greatest extraterritorially (Tåning 1929 p. 90).

Table 15. Average Size of Age-Groups (in cm's).

Age-Group.....	II	III	IV	V	VI	VII	VIII	IX
Territorial								
1924.....	—	24.7	28.1	30.8	33.2	34.7	38.8	41.7
1925.....	—	23.1	26.3	28.4	29.7	33.8	(36.8)	—
1926.....	—	(25.4)	27.9	30.1	31.7	33.6	37.1	37.0
1927.....	(13.0)	24.4	28.3	31.4	33.3	35.4	35.5	(40.0)
¹ 1928.....	—	(28.5)	30.9	33.4	34.1	36.8	(35.5)	—
¹ 1929.....	—	(28.9)	30.9	33.7	35.9	36.6	(41.2)	(47.5)
1930.....	—	—	—	—	—	—	—	—
1931.....	—	24.4	29.3	29.2	31.1	35.6	(34.4)	(51.0)
1932.....	(17.4)	23.6	25.8	29.0	31.9	36.8	(39.3)	(34.0)
1933.....	17.9	21.7	25.6	28.6	32.8	(32.0)	(37.3)	(43.0)
1934.....	(14.0)	19.7	22.6	25.2	27.0	(34.0)	—	—
1938.....	19.6	22.4	25.1	30.0	(29.0)	(33.0)	—	—
1939.....	23.1	23.5	24.5	28.3	(32.0)	—	(41.0)	—
Extra-territorial								
1924.....	—	26.2	29.5	32.7	35.0	36.1	40.6	40.4
1925.....	—	(26.5)	32.2	33.1	35.2	(36.1)	(38.5)	(36.0)
1926.....	—	(30.0)	30.3	32.7	33.4	(34.8)	(38.3)	(37.0)
1927.....	—	29.1	33.0	33.7	34.4	35.7	35.6	(38.0)
¹ 1928.....	—	(31.8)	33.3	34.3	33.5	(34.3)	(35.8)	—
¹ 1929.....	—	31.5	33.8	33.9	35.4	(38.8)	(34.0)	—
1930.....	—	—	—	—	—	—	—	—
1931.....	—	29.3	31.6	34.0	34.0	36.5	(35.3)	(36.0)
1932.....	(24.0)	26.4	29.3	30.9	31.7	(34.4)	—	—
1933.....	(17.5)	25.4	28.5	28.9	31.1	(30.0)	(34.0)	—
1934.....	—	(21.0)	28.3	29.6	30.8	(33.0)	—	—
1938.....	—	(26.7)	32.9	34.5	(38.0)	(36.0)	—	—
1939.....	(27.0)	(29.8)	29.8	(34.3)	36.0	—	—	(41.0)

() = numbers available less than 10 specimens.

¹ *Thor*.

per trawling hour in the territorial waters has been almost without exception considerably greater than the catch extraterritorially, the former usually lying between 50 and 130 spec. (average for 1924—34: 73 per trawling hour), whereas the latter has only been ca. 5—15 specimens (average for 1924—34: 11 per trawling hour). The territorial and not the ecological condition is the most important determining factor in this case. The material was collected by the "Dana" in 1924—39 with a 50-foot otter-trawl; the central position for the territorial station is 64°04' N., 22°35' W., and for the extraterritorial station 64°08' N., 22°23' W. The average sizes etc. are given in Tables 15—17. The trawling experiments of the "Thor" in 1927—29 at different seasons of the year showed that the density in the earlier months of the year may be higher extraterritorially than territorially, which is certainly due to the movement of the stock towards deeper water in the cold season; in agreement with this we find more small individuals on the stations mentioned early in the year than later (see Table 16).

It is of importance to note that the trawling experiments seem to show, that a closure of the

areas of special value for the growing plaice would undoubtedly lead to an increased weight output for the plaice fishery off the Bay, as well as for several other species which spend their first year in the Bay.

Fluctuations in the composition of the stock, with respect to age-groups, may be fairly large from year to year, but there is no need to discuss this subject here in more detail.

Various **marking experiments** have been carried out for some years in Faxe Bay and as these have yielded a number of interesting results, a few notes may be devoted to them.

Marking experiments of 1908—09 in Faxe Bay have been dealt with by BJARNI SÆMUNDSSON (1913); they included 732 plaice. Later similar experiments were carried out at the fixed stations territorially and extraterritorially in the years 1925, 1926, 1927, 1932 and 1938; 1839 plaice were marked in these years; the results have not yet been published. In the experiments of 1908—09, 32 % altogether were recaptured, in the 1925—27 experiments altogether about 21 %, in the 1932 experiment altogether 48 % and in the 1938 experiment altogether 41 %.

Table 16. Summary of Catches made at different Seasons by the "Thor" 1927—1929.

Season	Year	Total No. of Plaice	Trawling hours	No. pr. Trawling Hour	Average Size in cm.	Percentage < 23 cm. ≥ 28 cm.	
Territorial							
February...	1928	142	20	7	24.9	34.5	29.6
	1929	2,050	20	103	31.0	1.6	82.1
March.....	1927	871	20	43	33.0	2.7	84.0
April	1927	447	16	28	32.0	2.2	84.6
May	1928	768	20	38	32.3	11.6	66.9
May	1929	565	20	28	30.9	5.1	73.1
July	1929	1,259	18	70	30.3	4.6	68.9
August	1928	617	20	31	33.6	2.6	85.9
	1927	463	20	23	34.0	0.4	90.7
October....	1928	55	20	3	33.3	0.0	92.7
	1929	1,321	20	66	33.5	1.2	88.3
Extra-territorial							
February ...	1928	48	20	2	28.2	12.5	62.5
	1929	102	20	5	30.9	2.0	77.4
March.....	1927	842	20	42	27.0	14.0	49.8
April.....	1927	251	16	16	32.4	0.4	94.4
May	1928	87	20	4	32.1	0.0	86.2
	1929	111	20	6	35.0	0.0	100.0
July	1929	53	18	3	34.3	1.9	94.3
August	1928	108	20	5	34.5	0.0	98.2
	1927	124	20	6	33.5	0.0	97.6
October	1928	73	20	4	33.8	0.0	97.3
	1929	199	20	10	33.6	3.0	92.0

The experiments have shown, that the seasonal migrations of the plaice take them out into the Bay or out to the mouth of the Bay where the spawning grounds lie; some leave the area altogether, migrating either northwards along W. Iceland or to the south coast; these longer migrations are undoubtedly in the main for spawning purposes, to a less extent in search of food. In the 1908—09 experiments only 5 % of all recaptures were taken outside the Bay, north or south from there; in the 1925—32

experiments a similar proportion, namely only 6 % of all recaptures. In the 1938 experiment only 2 % were recaptured outside the Bay. By far the great majority were taken inside the Bay itself, in the course of the first and second years (ca. 90 % of all recaptures).

The marking experiments have yielded certain interesting data regarding, among other things, the changes taking place within the fishery; these will be mentioned in the following section.

III. Recent Changes in the Composition of the Stock in Faxe Bay

In the first section we have discussed from the statistical evidence the changes during the last ca. 30 years in the stock of plaice, induced chiefly by the trawl fishery.

Whilst, from the period before the war and immediately thereafter, we have no suitable material collected by research-vessels for comparison of the changes which have occurred in the plaice stock of Faxe Bay, from 1924 and following years we have some data that can be used. For the years 1924—27 and 1931—34 especially the material is strictly comparable, since the same vessel ("Dana") and the same gear (50-foot trawl) have been employed in the experiments. Since it was

just about 1930—31 that a great change occurred in the fishery in Faxe Bay, the Danish seine then coming into more effective use than before in the southern part of the Bay, comparison of the two periods will give an impression of the change which has occurred in the stock. It will be seen clearly from Table 17, that the quantity of small Plaice has greatly increased in the second period, with a simultaneous and corresponding decrease in the quantity of large plaice; this applies to both territorial and extraterritorial waters, which indicates that the change has also made itself felt out in the open Bay. (The size-limits 23 and 27 cm. in Table 17 have been selected

Table 17. Summary of Material from Trawlings by R/S "Dana" and S/S "Thor". 50' Ottertrawl.

Year Date	Total No. of Plaice	Trawling Hours	No. pr. Trawling Hour	Average Size ¹ in cm.	Percentage < 23 cm. ² ≥ 28 cm.	
Territorial						
1924, c. 1/7	3,493	32	109	32.4	2.6	81.3
1925, c. 1/8	3,116	20	156	29.3	4.5	65.1
1926, c. 1/7	1,272	31	41	31.3	1.0	84.0
1927, c. 1/8	3,672	30	122	31.5	4.7	80.5
³ 1928, c. 1/8	617	20	31	33.6	2.6	85.9
³ 1929, c. 1/8	1,259	18	70	30.3	4.6	68.9
1930,	—	—	—	—	—	—
1931, c. 1/8	2,602	20	130	28.3	22.8	56.6
1932, c. 1/7	553	28	20	27.0	22.4	48.3
1933, sec./8	568	11 ¹ / ₂	50	25.0	44.0	35.7
1934, prim./5	510	8	64	22.1	57.8	10.6
1938 ¹²⁻¹³ /7	445	10	45	24.1	43.0	20.4
1939 ²⁷⁻²⁹ /7	492	7	70	25.7	22.6	28.3
Extra-territorial						
1924, c. 1/7	743	51	15	33.9	2.2	90.3
1925, c. 1/8	81	19	4	33.5	1.2	91.4
1926, c. 1/7	63	26	2	33.3	0.0	98.4
1927, c. 1/8	355	25	14	33.8	0.6	96.6
³ 1928, c. 1/8	108	20	5	34.5	0.0	98.2
³ 1929, c. 1/8	53	18	3	34.3	1.9	96.2
1930,	—	—	—	—	—	—
1931, c. 1/8	212	20	11	32.8	0.5	94.3
1932, c. 1/7	432	28	15	29.6	3.2	75.2
1933, sec./8	452	11	41	28.0	6.4	58.6
1934, prim./5	85	5	17	28.8	8.2	60.0
1938, ¹¹⁻¹² /7	59	10	6	33.3	0	93.2
1939, ²⁷⁻²⁹ /7	80	7	11	32.0	0	82.5

¹ Not corrected by + 0.5 cm in the tables.² Material from fine-mesh covering net *not* included.³ *Thor*; other years *Dana*.

in accordance with the existing minimum sizes in England and Iceland).

The following summary shows, that whilst the quantities taken in the three periods have decreased for the territorial waters, they have not altered so much for the extraterritorial. In 1935—37 the "Dana" did not work in the Bay with the 50-feet otter-trawl.

	Number per trawling hour	
	<i>Territorial St.</i>	<i>Extraterritorial St.</i>
1924—1927:	102.2	10.3
1931—1934:	62.7	18.5
1938—1939:	55.1	8.2

The cause of the fall territorially may be referred directly to the fishery; possibly, in the period 1931—34, the numbers growing up in the bays and inlets may have been specially numerous and thus may have given larger contingents to the open parts of Faxe Bay, but unfortunately we have no material to determine this with certainty; but it is also probable, that the trawlers owing to the decreasing quantities of fish in the southern part of

the Bay have moved their operations to other fields in the Bay and outside it, and this would lead to an increase extraterritorially of the migrating individuals.

In Table 18 we obtain evidence of the striking difference which has arisen in the stock's composition of age-groups. Both inside and outside the territorial limit in the period 1924—27 the dominant groups were IV—VII, in 1931—34 on the other hand III—V, and in 1938—39 with a falling tendency, especially in the territorial area.

The following data summarise this condition very clearly:

Average Percentage of the different Age-Groups.

<i>Territorial</i>				
Age-groups...	II—III	IV—V	VI—VII	VIII +
Years				
1924—1927...	2.7	25.5	19.2	1.8
1931—1934...	16.2	26.0	6.7	0.8
1938—1939...	25.2	26.3	0.8	0.1
<i>Extraterritorial</i>				
1924—1927...	2.5	24.0	20.6	1.9
1931—1934...	6.5	34.0	9.1	0.2
1938—1939...	5.5	39.1	5.3	0.2

Table 18. Percentage of the different Age-Groups for the years 1924—1934.

Age-Group	II	III	IV	V	VI	VII	VIII	IX	X +	Total No. examined
Territorial										
1924.....	0.0	1.4	19.8	21.8	21.4	30.2	3.2	1.9	0.4	1,969
1925.....	0.0	9.8	28.2	46.9	8.2	4.5	2.5	0.0	0.0	245
1926.....	0.0	2.1	14.2	25.9	43.9	6.7	2.9	3.7	0.5	374
1927.....	0.0 ¹	7.9	18.2	29.2	22.0	16.8	4.5	0.5	0.9	470
² 1928.....	0.0	6.4	21.3	35.1	22.3	10.7	4.3	0.0	0.0	94
² 1929.....	0.0	7.8	26.7	32.8	14.7	12.1	4.3	1.7	0.0	116
1930.....	—	—	—	—	—	—	—	—	—	—
1931.....	0.0	15.6	26.8	25.1	18.0	10.1	3.9	0.6	0.0	179
1932.....	2.5	24.4	48.4	11.6	6.6	4.1	1.3	0.9	0.3	320
1933.....	8.8	39.1	17.0	26.9	5.1	1.4	0.8	0.3	0.6	353
1934.....	0.5	39.0	40.7	11.2	7.5	0.8	0.0	0.0	0.3	374
1938.....	4.0	60.4	22.8	10.7	1.7	0.3	0.0	0.0	0.0	298
1939.....	3.8	22.6	63.4	8.4	1.0	0.0	0.7	0.0	0.0	288

Extra-territorial

1924.....	0.0	4.1	19.6	23.7	18.7	27.9	3.1	1.9	1.0	700
1925.....	0.0	7.8	16.9	41.6	18.2	9.1	5.2	1.3	0.0	77
1926.....	0.0	1.6	15.9	23.8	42.9	9.5	4.8	1.6	0.0	63
1927.....	0.0	6.5	17.4	33.2	24.7	14.1	3.2	0.6	0.3	355
² 1928.....	0.0	9.9	35.2	20.9	22.0	7.7	4.4	0.0	0.0	91
² 1929.....	0.0	23.9	31.2	30.3	10.1	3.7	0.9	0.0	0.0	109
1930.....	—	—	—	—	—	—	—	—	—	—
1931.....	0.0	10.0	34.3	32.4	16.7	4.8	1.4	0.5	0.0	210
1932.....	0.4	10.4	53.2	22.4	10.4	3.2	0.0	0.0	0.0	250
1933.....	0.9	21.9	28.2	41.6	5.4	1.8	0.2	0.0	0.0	447
1934.....	0.0	8.2	36.5	24.7	25.9	4.7	0.0	0.0	0.0	85
1938.....	0.0	8.4	38.3	48.3	1.7	3.3	0.0	0.0	0.0	60
1939.....	1.4	12.3	60.3	9.6	15.1	0.0	0.0	1.4	0.0	73

¹ < 0.1

² *Thor*

We might expect that the average size of the individuals belonging to the different age-groups would be on the increase, since competition between them has been reduced; this is, however, not the case, especially not in the years 1931—34, as will be seen from Table 15. The fishery takes first the larger specimens.

The marking experiments mentioned above give a certain amount of information showing clearly the change of the fishery in the Bay. The following table contains a condensed summary of the plaice recaptures, all specimens having been marked just at the places where the experimental

Percentage of recaptured Plaice marked in Faxa Bay.

Territorial:	No. marked	% recaptured	
		1st year	2nd—5th year
1908—1909.....	236	2.5	15.3
1925—1927.....	596	6.5	11.8
1932.....	150	38.0	4.7
1938.....	150	44.7	6.6
Extraterritorial:			
1908—1909.....	131	55.0	3.9
1925—1927.....	643	17.4	5.0
1932.....	150	40.0	13.4
1938.....	150	20.7	10.0

trawlings were made. The size of the marked plaice lies mainly between about 25 and 40 cm.

Whilst the condition earlier was, that the plaice marked within the territorial limit only became the victims of the fishery after they had migrated outwards in the Bay in their second and later years after marking, in 1932 and 1938 they are caught by the fishermen soon after marking. For this reason a certain amount of protection of the growing plaice stock both inside and outside the limit has become more and more desirable.

As mentioned above, the Icelandic Government has in recent years imposed bye-laws dealing with the closure of the Bay for Danish seine at a certain period of the year, together with regulation of minimum sizes and size of mesh.

In the period before the war, when Faxa Bay yielded a large part of the plaice catch landed in England from Iceland, the fishery in the open Bay was almost just as intensive as in recent years. This fact, as also the relative proportions taken, formerly and now, (in 1925—32), by the different countries fishing in the Bay, can be seen from Table 19, which includes all the marking experiments from the Bay that can be used (the marking grounds are marked as "intra" and "extra"; the

Table 19. Percentage of Recaptures according to Nationality of Vessel.

Loc. of marking	Great Britain		Iceland		Other countries ¹		Total tagged and recapt.		% recaptures	
	intra	extra	intra	extra	intra	extra	intra	extra	intra	extra
Period 1908—1909	87.6	92.2	9.8	7.8	2.6	0	520/153	131/77	29.4	58.8
" 1925—1927	77.5	86.8	18.0	9.7	4.5	3.5	596/111	643/144	18.6	22.4
" 1932	10.9	77.5	89.1	21.3	0	1.2	150/64	150/80	42.7	53.7
" 1938	11.7	60.9	88.3	39.1	0	0	150/77	150/46	51.3	30.7

¹ Germany, Holland, Belgium, France, Denmark.

place of recapture is most usually given by the fishermen as "Faxa Bay" etc.).

It will be noted, how the proportion taken by British trawlers has declined, whilst the numbers taken by Icelandic fishermen have increased in the

years 1925—38; this applies especially to plaice marked inside the territorial limit.

(Supplementary material for the years 1938—39 has been added to this report in 1946.)

LEMON SOLE IN FAXA BAY

BY

BENNET B. RAE

Scientific investigations were carried out in Faxe Bay in almost every year from 1924 to 1938. The material collected by the various research vessels visiting the area comprises measurements, sex determinations, maturities and scale samples of lemon soles which now form the subject of the present report.

As will be seen from Fig. 9 the principal distribution of this species is largely restricted to the south and south-west part of the coasts (see also Paper 21).

Distribution. Lemon soles are found throughout Faxe Bay, with the exception perhaps of the north-east corner, where repeated blank hauls have been made. Most of the sampling has been carried out in the shallow water (30—40 metres) of the southern section of the Bay, where the population appears to be most dense. Good hauls have also been made in the Jokuldjup, in the central and outer part of the Bay at depths of 150 metres. The results of regular sampling at positions within and without territorial limits in the southern half of the Bay are given in Table 20¹.

A number of features may be noted from a study of this table. In the first place it is seen that larger catches are obtained during the summer months, from May to August, than at other times. This, however, is not peculiar to this region but is characteristic of the lemon sole fishery on other Icelandic grounds, at Faroe and in the North Sea.

Secondly, the numbers caught per ten hours' fishing in all but a few instances are greater in territorial waters than in extraterritorial waters.

Thirdly, between 1924 and 1929 a steady decline occurs in the numbers of lemon soles taken per unit of fishing time. In 1931 there follows a sudden increase which is maintained until 1938—39, when the numbers per ten hours' fishing with the 50 ft. otter trawl are actually the highest recorded from territorial waters during the whole period.

Length Measurements. Considerable variation occurs in the size frequencies throughout the period under review (*vide* Table 21).

From 1924 to 1927 the numbers in the smallest size-groups in Faxe Bay decline steadily so that few lemon soles of less than 26 cm. are found in the 1927 records. This poor recruitment naturally results in an increase in the average size of the stock and, although the numbers of larger fish are well maintained up to 1927 at least, the reduction in the numbers of fish caught per unit of fishing time, noted on Table 20, is therefore most pronounced in the smaller size groups. In 1931 the smallest fish are well represented in the catches and in the following years the numbers are maintained with variations due to differences in brood strength.

In addition to these fluctuations in the frequencies in the 5 cm. groups another change is visible in the decline in the numbers of the larger fish caught per unit of fishing time from 1927 onwards. For example the number of lemon soles from 41—45 cm. caught per ten hours' fishing falls from 7 in 1927 to less than 2 in 1938. The high percentages of larger fish in 1937 are somewhat misleading since they are due to the sampling of grounds in Jokuldjup, which are much less intensively fished commercially.

Age Determination. Age determination has been carried out entirely by means of scale examination. When scales are obtained from the proper position on the body of the lemon sole (the lateral line about two-thirds of the length backwards from the mouth) little difficulty is encountered in deciding the age of the fish. Occasionally, however, the small scale increments in older fish render the determination of the correct age rather difficult, especially if associated with false rings or checks in the scale growth. It must be admitted, therefore, that some doubt exists regarding the age of a small percentage of fish of ten years of age and over. This, however, in no way alters the general truth of the statements on age analysis.

¹ See also Paper 20, pp. 94 and 98 and Paper 21.



Fig. 9. Chart showing Trawling Positions of Research Vessels and Number of Occasions on which Grounds were sampled 1924—1939 (except in southern end of Faxe Bay where sampling is too frequent to show on chart).

Catches of Lemon Sole: 1: blank; 2: light; 3: medium; 4: heavy.

Table 20. Numbers of Lemon Soles caught per 10 hours' fishing in southern section of Faxe Bay.

Year	Month	Vessel	Gear	Territorial	Extraterritorial
1924	June—July	Dana	50' O.T.	154	39
1925	June	Explorer	50' O.T.	100	—
"	"	"	Comm. Trawl	840	140
"	July—Aug.	Dana	50' O.T.	93	22
1926	June—July	"	50' O.T.	71	1
1927	March	Thor	50' O.T.	4	0
"	April	"	50' O.T.	22	4
"	July—Aug.	Dana	50' O.T.	118	5
"	October	Thor	50' O.T.	37	2
1928	February	"	50' O.T.	3	0
"	May	"	50' O.T.	31	0
"	August	"	50' O.T.	52	1
"	October	"	50' O.T.	2	2
1929	February	"	50' O.T.	2	0
"	May	"	50' O.T.	42	1
"	July	"	50' O.T.	62	8
"	October	"	50' O.T.	132	8
1931	July	Dana	50' O.T.	136	127
1932	July	"	50' O.T.	107	77
1933	August	"	50' O.T.	93	153
1934	May	"	50' O.T.	45	52
1936	June	Nautilus	Comm. Trawl	175	180
"	July	George Bligh	Comm. Trawl	1,880	1,020
"	July	Thor	Comm. Trawl	454	—
"	May	Thor	Comm. Trawl	496	224
1937	May	Nautilus	Comm. Trawl	205	60
"	October	Thor	Comm. Trawl	248	8
1938	February	"	Comm. Trawl	74	1
"	June	"	Comm. Trawl	663	180
"	July	Dana	50' O.T.	301	49
"	December	Thor	Comm. Trawl	234	1
1939	July	Dana	50' O.T.	519	76

Table 21. Size Frequencies of Lemon Soles caught in Faxa Bay by Research Vessels.

	In percentages							Total	Number
	Cm. < 21	21—25	26—30	31—35	36—40	41—45	46—50		
1924	2.8	22.8	29.3	19.0	16.9	8.6	0.7	100.1	706
1925	0.6	7.7	36.5	30.5	18.0	6.4	0.3	100.0	312
1926	0.9	9.2	36.6	30.4	13.2	9.7	—	100.0	227
1927	—	4.6	20.1	39.8	23.0	12.3	0.2	100.0	374
1931	15.1	22.9	27.5	20.6	8.9	4.8	0.2	100.0	524
1932	8.2	33.8	33.5	15.6	4.6	4.0	0.3	100.0	328
1933	7.6	23.6	46.2	12.0	7.3	2.2	1.1	100.0	275
1934	3.3	37.7	26.2	16.5	9.8	4.9	1.6	100.0	61
1935	1.0	17.0	49.0	26.0	5.0	2.0	—	100.0	100
1936	18.5	24.6	33.8	16.7	4.4	2.0	—	100.0	1,189
1937	1.2	30.4	35.5	10.1	12.1	8.7	2.0	100.0	504
1938	14.9	34.1	35.5	9.9	4.3	1.1	0.2	100.0	537

The age analyses of the catches of the research vessels are given in Table 22.

During the period under review eighteen different age-groups are represented in the catches, ranging from 1+ to 18+ years of age, although in recent years there is a tendency for the number of age-groups to diminish. In the 1+ group there is only a single record, obtained in 1931 in extraterritorial waters and measuring 7.4 cm. Even 2+ fish are remarkably scarce, especially if the numbers are compared with those of the same age taken at

Faroe and in the North Sea. Thus any attempt at forecasting the strength of any brood is impossible, with the present method of sampling, before the fish are 3 or 4 years of age.

From a study of the percentages of the different broods composing the annual catches it is possible to ascertain, to some extent, the relative strengths of the broods and to trace their influence in the maintenance of the stock.

A glance at the figures for the earlier years of the period explains the scarcity of small fish refer-

Table 22. Age Analysis of Lemon Soles from Faxa Bay.

Year Year-Brood	1925	1926	1927	...	1931	1932	1933	1934	1935	1936	1937	1938
1936	—	—	—		—	—	—	—	—	—	0.0	0.5
1935	—	—	—		—	—	—	—	—	0.0	0.0	14.0
1934	—	—	—		—	—	—	—	0.0	1.5	15.9	30.7
1933	—	—	—		—	—	—	0.0	0.0	20.2	33.5	31.0
1932	—	—	—		—	—	0.0	0.0	2.0	17.8	21.5	8.8
1931	—	—	—		—	0.0	0.7	0.0	3.0	6.9	7.7	1.8
1930	—	—	—		0.2	2.4	13.6	29.4	31.0	34.6	12.0	6.3
1929	—	—	—		2.0	4.6	6.6	15.7	8.0	3.8	3.4	0.9
1928	—	—	—		18.2	35.7	46.9	27.5	29.0	7.5	2.6	2.7
1927	—	—	—		21.4	30.8	13.9	5.9	15.0	2.5	2.1	0.9
1926	—	—	0.0		21.6	11.0	4.4	2.0	5.0	1.8	1.3	0.9
1925	—	0.0	0.0		9.4	3.1	3.7	3.9	1.0	1.1	—	0.9
1924	0.0	0.0	0.0		1.4	1.5	1.1	0.0	1.0	0.4	—	0.0
1923	0.0	1.3	6.6		6.4	3.1	4.7	11.8	2.0	1.1	—	0.6
1922	0.0	0.0	0.0		1.6	2.4	1.1	1.9	0.0	0.4	—	—
1921	0.0	0.0	1.6		2.0	0.9	0.4	0.0	2.0	0.0	—	—
1920	28.2	43.1	31.6		8.4	2.4	1.8	1.9	0.0	0.4	—	—
1919	28.7	15.6	17.2		2.6	0.3	0.0	—	1.0	—	—	—
1918	3.8	2.7	3.5		1.4	0.6	0.4	—	—	—	—	—
1917	4.8	5.3	6.5		2.0	1.2	0.7	—	—	—	—	—
1916	1.9	2.7	4.9		0.8	—	—	—	—	—	—	—
1915	5.7	8.5	12.5		0.4	—	—	—	—	—	—	—
1914	4.3	4.9	6.5		0.2	—	—	—	—	—	—	—
1913	5.3	4.4	3.5		—	—	—	—	—	—	—	—
1912	6.7	6.2	3.3		—	—	—	—	—	—	—	—
1911	3.8	2.7	1.4		—	—	—	—	—	—	—	—
1910	2.9	1.3	0.9		—	—	—	—	—	—	—	—
1909	2.4	1.3	—		—	—	—	—	—	—	—	—
1908	1.0	—	—		—	—	—	—	—	—	—	—
1907	0.5	—	—		—	—	—	—	—	—	—	—
Total	100.0	100.0	100.0		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number	209	225	367		500	328	273	51	100	549	233	449

Table 23. Size Frequency of Lemon Soles from Territorial and Extraterritorial Positions of Faxe Bay

		In percentages								Total
		cm.	< 21	21—25	26—30	31—35	36—40	41—45	46—50	% Number
1924 June/July	Territorial	2.2	21.6	28.8	19.8	19.5	7.3	0.8	100.0	504
	Extraterr.	4.6	26.5	30.1	16.3	10.2	11.8	0.5	100.0	196
1931 July	Territorial	19.2	32.5	23.6	15.5	6.6	2.6	—	100.0	271
	Extraterr.	10.7	12.7	31.6	26.1	11.4	7.1	0.4	100.0	253
1932 July	Territorial	9.4	46.7	21.5	11.2	6.5	4.7	—	100.0	107
	Extraterr.	7.3	27.4	39.7	17.8	3.7	3.7	0.4	100.0	219
1933 August	Territorial	—	18.7	57.0	15.0	6.5	2.8	—	100.0	107
	Extraterr.	12.5	26.8	39.3	10.1	7.7	1.8	1.8	100.0	168
1936 June/July	Territorial	22.0	26.0	25.8	16.9	6.4	2.9	—	100.0	658
	Extraterr.	13.5	23.5	46.8	14.7	1.2	0.3	—	100.0	408
1938 July	Territorial	16.2	37.0	35.5	7.8	2.2	1.1	0.2	100.0	462
	Extraterr.	9.1	20.0	47.3	20.0	3.6	—	—	100.0	55

red to in the last section. This is due to the complete failure of the 1921 and 1922 broods in the southern half of Faxe Bay and to their consequent absence from the catches a few years later, at a time when they should, normally, be making their appearance in good numbers. From 1931 onwards both these broods are present in very small proportions but this may be due to immigration. In addition to the failure of the 1921 and 1922 broods, those of 1923—24—25 are all poor or of poor-medium strength, thus rendering the scarcity of lemon soles still more acute — a condition which is reflected in the extraordinarily small numbers taken per ten hours' trawling in 1928—29 (*vide* Table 20).

The appearance of large numbers of small fish from 1931 to 1938 is clearly the result of the emergence of a number of prolific year classes.

Thus, although the reduction in the numbers of older and larger fish caught per unit of fishing time is no doubt due in part to intensity of commercial trawling, it is also due in some measure to a scarcity of older and larger fish, as a result of the period of poor recruitment from 1921 to 1925. This fact, in conjunction with the appearance of four prolific broods within the period 1928—34, is also partly the cause of the remarkable fall in the average size of the stock.

In the light of experience derived from a study of lemon soles at Faroe and in Scottish waters, it is possible from Table 22 to make a rough classification of the broods according to their relative strengths in Faxe Bay. The following grouping of the broods may be suggested.

Good	1920, 1928, 1930, 1933, 1934
Medium -Good	1919, 1926, 1927, 1932
-Poor	1923, 1925, 1929
Poor	1921, 1922, 1924, 1931

Comparison of Territorial and Extraterritorial Stocks. Considering the importance of the records from territorial and extraterritorial waters, some comparison of the two positions sampled is of interest, in view of the conditions and regulations relating to fishing in the bay. The data for the most heavily sampled years are set forth in Table 23 (Size) and Table 24 (Age).

Tables 23 and 24 show that in size and age the lemon soles of territorial waters differ little from those of extraterritorial waters. There is a tendency for the proportions of larger and older fish to be slightly greater at extraterritorial positions but this does not apply in every case. As regards the youngest fish the numbers of 2+ and 3+ fish in territorial waters exceed those from the extraterritorial position in 1931 and in 1938, but in 1924

Table 24. Age Frequency of Lemon Soles from Territorial and Extraterritorial Positions of Faxe Bay.

Year Month			1931 July		1932 July		1933 August		1936 June/July		1938 July	
Age			Terr.	Extra	Terr.	Extra	Terr.	Extra	Terr.	Extra	Terr.	Extra
2 + —	3 +	%	25.7	10.5	8.4	6.4	4.7	20.5	25.7	8.0	19.0	7.4
	4 +	%	23.4	20.2	38.3	33.8	7.5	6.0	15.6	25.4	31.6	22.2
	5 +	%	21.4	22.8	22.4	35.1	48.6	45.8	5.9	11.1	30.6	31.5
	6 +	%	3.9	16.2	10.3	11.4	19.6	10.3	30.2	49.2	7.6	18.5
	7 +	%	1.5	1.3	2.8	3.2	7.5	2.4	4.5	1.6	1.0	3.7
	8 +	%	8.1	4.8	1.9	1.4	2.8	4.2	8.7	3.1	4.6	14.8
	9 +	%	1.5	1.8	5.6	1.8	0.9	1.2	3.3	—	0.7	—
10 + —	12 +	%	10.7	16.2	8.4	4.6	6.6	6.0	4.0	0.8	3.6	1.9
13 + —	15 +	%	3.4	5.3	1.9	2.3	0.9	3.0	1.9	—	1.3	—
16 + —	18 +	%	0.4	0.9	—	—	0.9	0.6	0.2	0.8	—	—
Total			No.									
			%									
			261	228	107	219	107	166	423	126	301	54
			100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 25. Average Sizes of Lemon Soles in Faxe Bay. Caught 21st June to 21st August 1925—38.

Age	Territorial				Extraterritorial			
	No.	Range cm.	Mean cm.	Incr. cm.	No.	Range cm.	Mean cm.	Incr. cm.
1+	—	—	—	—	1	—	7.4	—
2+	9	12—14	13.4	—	21	11—16	13.4	6.0
3+	241	13—24	19.5	6.1	75	14—25	19.7	6.3
4+	289	18—28	23.7	4.2	175	20—30	24.5	4.8
5+	306	20—34	27.2	3.5	237	20—35	27.9	3.4
6+	343	23—37	29.2	2.0	162	20—39	30.0	2.1
7+	176	25—38	31.2	2.0	28	27—38	31.8	1.8
8+	147	27—40	33.1	1.9	39	26—38	33.6	1.8
9+	56	27—41	34.5	1.4	10	28—41	34.8	1.2
10+	67	27—43	36.0	1.5	21	28—47	37.5	—
11+	74	28—44	36.6	0.6	25	27—42	36.2	—
12+	79	31—45	37.9	1.3	16	34—45	39.7	—
13+	60	29—45	39.1	1.2	8	33—48	40.9	—
14+	43	30—44	38.8	—	6	36—43	41.2	—
15+	26	30—46	40.9	—	10	33—47	41.7	—
16+	16	33—45	40.8	—	3	41—46	43.3	—
17+	8	33—45	40.5	—	1	—	45.0	—

and 1933 the reverse conditions prevail and the youngest age-groups are more numerous in extraterritorial waters. It would appear, therefore, that neither in their size frequencies per 5 cm. groups, nor in their age composition do the lemon sole stocks of territorial waters differ in any essential or permanent manner from those of extraterritorial waters.

Growth. The growth of lemon soles from Faxe Bay is studied in the same manner as those from Faroe and the North Sea by directly combining the age determinations and measurements to arrive at averages. Most of the samples are from the month of July but, in view of the slow growth-rate and wide range in the size of fish of each age-group, samples from the end of June and the beginning of August are also included. Again, only records from the territorial and extraterritorial positions

are utilised and, for comparison, these are considered separately (*vide* Table 25 and Figure 10). It is found that the average sizes for territorial waters are slightly smaller in almost every age group. Up to 13 years of age the average amount by which the extraterritorial figures exceed the territorial figures is about 0.8 cm.

In comparison with the growth of lemon soles at Faroe and in the North Sea the growth in Faxe Bay is inferior to the very good growth of northern Faroese grounds, but is somewhat better than the Sydero type. Up to 7 years of age the Faxe Bay type resembles most closely the Moray Firth type in Scottish waters. After this age, growth is relatively poorer in Faxe Bay. On the whole the rate of growth in Faxe Bay may be regarded as good by standards of lemon sole growth elsewhere.

Although it is difficult to obtain strictly comparable figures for each year, owing to different times of sampling and to the fact that growth may be delayed, or even less prominent, in certain years, there is little or no evidence of any change in the growth rate coincident with the changes in the size and age composition of the stocks during the period under observation.

Before leaving the question of growth it is interesting to note the different rates of growth in the sexes. Slight during the first few years of life, this difference becomes more prominent from six years of age onwards, until it varies from 5 to 10 cm. in the oldest age classes (*vide* Table 26 and Figure 10).

Proportions of Sexes. In dealing with Faroese lemon soles¹ it was pointed out that the female fish outnumber the males in most samples. This also applies to Faxe Bay. In this instance the data are more numerous and therefore worthy of more

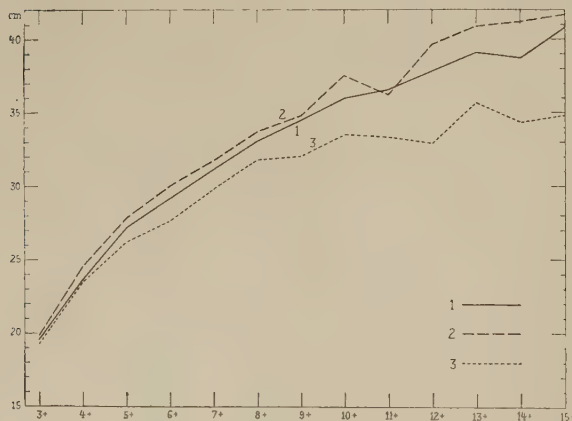


Fig. 10. Lemon Sole Growth in Faxe Bay. Average Sizes of the various Age-Groups, 21st June—21st August, 1925—1938.

1: Territorial; 2: Extraterritorial; 3: Males (territorial).

¹ B. B. RAE: Lemon Soles at Faroe, 1923—1938. Rapp. et Proc-Verb., Vol. CIX, Appendix 2.

detailed investigation. Distinction is again made between territorial and extraterritorial waters and it is found that, in the former, the annual percentages of males vary from 33 to 60 with an average of 42, while the percentages of females vary from 40 to 67 with an average of 58. In extraterritorial waters the corresponding figures for males are 23 to 47, average 37 and for females 53 to 77, average 63. The ratio of males to females is, therefore, relatively greater in territorial waters.

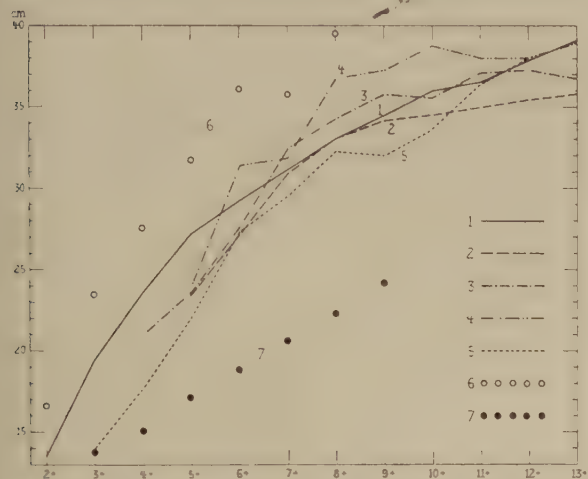


Fig. 11. Lemon Sole Growth at Iceland. Average Sizes of the various Age-Groups, July 1925—1938.

1: Faxa Bay (Territorial); 2: Reykjanes; 3: Vestman Isles; 4: Portland; 5: Ingolfshöfði; 6: N. Myggenaes (May—June); 7: N. Rona (May—June).

Another feature regarding the proportions of the sexes is seen in examining the proportions at different ages. In the earlier years of life, up to 5+, the males outnumber the females in the majority of samples. After 6 years of age the females predominate and particularly with advancing age so that few male fish are found in the oldest age groups.

There is reason to believe, therefore, that the poorer growth of males and the higher proportions of males in territorial waters are, in some measure, responsible for the slightly poorer growth-rates of the species as a whole within territorial waters although this is probably mainly due to the denser population and the consequent greater competition for food.

Table 26. Average Sizes of Male and Female Lemon Soles in Territorial Waters of Faxa Bay.

21st June to 21st August 1925—1938.

Age	MALES			FEMALES		
	No.	Range cm.	Mean cm.	No.	Range cm.	Mean cm.
3+	116	13—24	19.3	121	15—24	19.7
4+	159	18—28	23.6	129	18—28	23.9
5+	124	22—31	26.2	167	20—34	27.8
6+	138	23—34	27.6	195	25—37	30.2
7+	71	25—35	29.8	104	27—38	32.1
8+	40	27—39	31.8	105	27—40	33.5
9+	19	30—35	32.0	36	27—41	35.9
10+	20	30—38	33.5	44	27—43	37.1
11+	18	28—39	33.3	53	29—44	37.7
12+	22	31—37	32.9	53	35—45	39.9
13+	16	29—45	35.7	38	32—45	40.3
14+	12	30—40	34.3	30	34—44	40.5
15+	4	30—38	34.8	20	39—46	42.2
16+	2	33—34	33.5	12	39—45	41.8
17+	2	33—39	36.0	4	39—45	41.5

Spawning: The present data adds little to our knowledge of the spawning of lemon soles in Faxa Bay except to confirm that some spawning does take place there, perhaps even within territorial waters.

Migration: A number of lemon soles were marked and liberated in Faxa Bay in 1925, but the results were insufficient to form the basis of any reliable conclusions. It would appear, however, that some migration of adult lemon soles from the bay does take place, probably in a southerly and then easterly direction. The presence of a higher proportion of younger fish in the southern half of Faxa Bay than on other Icelandic grounds seems to support this view.

THE HADDOCK AT ICELAND WITH SPECIAL REFERENCE TO FAXA BAY

BY

D. S. RAITT †

Present day information regarding the characteristics of the stock of adult haddock at Iceland is of comparatively recent origin being mainly due to the investigations of SÆMUNDSSON, 1925, THOMPSON, 1929, and RAITT, 1936. Knowledge as to the occurrence of eggs and fry stages in the different spawning regions throughout the north-east Atlantic dates from the classical work of SCHMIDT, 1909.

Independence of Icelandic Stock. SCHMIDT found that throughout the whole of the area he investigated, extending from Iceland to Spain, the pelagic eggs of the species seldom occur over grounds of less than 50 or more than 200 metres deep, or out-with waters of from 5° to 10° C., or in salinities of less than 34.5 per mille. Grounds of less than 200 metres deep are restricted at Iceland to a narrow shelf around the coastline. There is, however, a considerable range in hydrographic conditions. The south and south-west coasts are exposed to the main onset of the warm Atlantic drift which thereafter has a westerly trend till it converges on the north coast with the Polar current system. The latter prevails in the north in winter but in summer the former extends its influence as far as the north-east. The waters of the east coast are the coldest, being under the influence of the southward flow of the Polar current. There is thus an anti-cyclonic system of surface drift around the island, and the products of haddock spawning, within the narrow 200-metre shelf, are retained within the region, safe from the major water movements of the open ocean and separate from the eggs and fry of other 200-metre areas.

Time and Location of Spawning. The work of SCHMIDT upon the occurrence of the young stages, coupled with the subsequent investigations of SÆMUNDSSON and THOMPSON, has further shown that the spawning grounds of the haddock of Iceland are located on the warmer south and west

coasts, and that the height of the spawning period is in April, at which time the temperature to the north and east is far below the minimum at which the haddock spawns anywhere throughout its distribution.

Seasonal Migrations. After spawning, according to SÆMUNDSSON, the spent fish enter the shallower water of the south and west coasts to feed upon great shoals of sandeels. Between July and November they migrate northerly and easterly to feed on deeper and more distant grounds, re-appearing again in the spawning region from December onwards. The biology of the species in its immature years at Iceland has still fully to be elucidated. It would appear, however, that, normally, the products of a spawning season take to bottom habitat in water of moderate depth, 10 to 120 metres, in the vicinity of the south and west coasts, but fry experiencing a prolonged period of pelagic drift may be carried as far as the north coastline by the anti-cyclonic current system of the region. Thereafter shoal movements become extensive only when maturity is reached, although a movement of small and medium-sized immature fish from deeper water into the shallows of the south and west coasts gives rise to a summer and autumn inshore fishery there.

Advent of Maturity. The advent of maturity in the haddock of Iceland is given both by SÆMUNDSSON and THOMPSON as taking place at the end of the fourth or fifth year of life. THOMPSON considers the latter to be the average age, that is some two years later than in the North Sea.

Rate of Growth. The rate of growth of Icelandic haddock is, after the first year of life, amongst the fastest known for the species. The following are the average sizes attained in different regions at different ages. The data pertaining to the Murman coast are taken from SIVOROV and WADOWA, 1932, and the remainder are as given by THOMPSON, 1929.

Table 27.

Age	1	2	3	4	5	6	7	8	9	10	11	12	13
Murman Coast.....	—	—	38.2	47.4	55.7	62.1	69.8	76.6	80.5	82.4	—	—	—
Iceland.....	16.5	30.6	39.7	47.9	55.1	60.4	64.0	68.8	72.0	75.5	77.6	79.2	82.0
Faroe.....	16.5	31.7	41.6	48.3	54.8	60.6	65.8	69.6	72.8	74.4	—	—	—
Norway.....	18.1	29.4	36.6	44.5	51.2	54.7	58.3	63.0	68.0	71.2	73.0	74.4	75.0
North Sea.....	17.1	24.5	29.5	33.5	37.0	41.0	—	—	—	—	—	—	—

Compared with that of the North Sea, the Icelandic stock is, on the average, about 0.6 cm. less in length at the end of the first year, but its superiority over the former at the ages of 2, 3, 4, 5 and 6 years amounts to 6.1, 10.2, 14.4, 18.1 and 18.6 cm. respectively.

Differences in the Icelandic growth-rate according to locality are distinguishable up to the age of 5 years, after which time the differentiation is obscured by the congregation of mature fish on the spawning grounds of the south and west coasts. Up to the age of 5 the region of fastest growth is around Ingolfshöfði in the south-east. There is a fall towards the west, and still greater reductions in the north and round the east. The downward gradient of mean annual temperature follows the coastline in the same direction. By the fifth summer a maximum size variation of about 19 cm. exists between the best and poorest growth localities.

Food. According to THOMPSON, 1928, the diet on the north and north-west coasts consists of brittle-stars, worms, and schizopods. On the south, in contrast, sandeels are practically the only item sought, and the volume taken is very high. With the advent of summer conditions, however, sandeels and capelin also become available in the north and east.

Stock Fluctuations. Assessments of the fluctuations which have occurred in the recruitment of the Icelandic stock by new broods were brought up to date by RAITT, 1936. Summarising all available data it was seen that the incidence of good and bad years there in no way coincided with that of the North Sea or any other stock. While, normally, new year-groups originate in the south and west and are only sparsely represented elsewhere, exceptional years have occurred in which broods have been in greatest density in the north or east. Upon the basis of the greatest frequency found on any coastline, the degrees of success of the different broods from 1916 to 1934 were as given in Table 28.

The broods of 1920, 1921 and 1922, were in greatest frequency on the north coast, falling into the Moderate, Good, and Very Good categories, respectively, while in the south and west they were Poor, Poor, and Moderate. The brood of 1925 was Very Good both in the north and east and only

Moderate in the south and west. The 1932 year-class was Very Good all over. The remaining 14 age-groups were in greatest density in the south and west.

From 1917 to 1920 there occurred four consecutive broods which were below Normal strength. There followed, from 1921 to 1925, five broods which were above Normal but for 1923 which was Normal. From 1926 to 1930 there were five broods again of below Normal strength but for 1929 which was Normal. Compared with the North Sea there has thus been at Iceland a much greater tendency for the occurrence of spells of good and of bad survival years.

Constitution of Commercial Catches. THOMPSON, 1928, writes, "The Icelandic Haddock fishery reacts particularly sensitively to the periodicity in the type of productivity of year broods, since the major portion of the commercial catches consists of immature fish (up to 4 or 5 years of age). The possible forecasting of the probable course of the fisheries therefore depends upon an accurate knowledge of the relative frequency of the newer broods and their location while young."

Faxa Bay. Faxa Bay, on the south-west of Iceland, includes extensive waters down to about 140 metres. By its location and depth it is thus to be regarded in its outer reaches as a normal spawning ground of Icelandic haddock and in general as a normal habitat of the immature year-classes which form the major portion of commercial catches.

The growth-rate of the haddock of the Faxa Bay region is slower than on the south coast, but faster than in the north and east. The maximum difference in mean size between the west and the south, age for age, is given by THOMPSON, 1928, as 5 cm.

While no separate survey of the species in Faxa Bay has so far been published, its haddock population must obviously be considered in the light of its relationship to the general stock of Icelandic waters.

Further information on the haddock in Faxa Bay will be found in STRUBBERG: Paper 20 of this report and HAROLD THOMPSON in Rapp. et Proc. Verb., Vol. LVII, 1929.

Table 28.

First Year Av. Catch per 10 hrs.	Category	Year-Class	
500	Poor	1919, 1927, 1929	= 3
1000	Moderate	1917, 1918, 1920, 1926, 1930, 1934(?)	= 6
2000	Normal	1923, 1928, 1933,	= 3
4000	Good	1916, 1921, 1924, 1932	= 4
6000	Very Good	1922, 1925, 1931	= 3

ON THE COD IN FAXA BAY

BY

ÁRNI FRIDRIKSSON

As is well-known, the cod is one of the most important food-fishes in European waters. A glance at the *Bulletin Statistique* for the year 1934 (chosen at random) shows that, out of a total catch of 3,422,724 tons for that year the cod alone made up 1,032,119 or roughly 30 %. The same year the cod catch for Iceland grounds amounted to 438,569 tons, which is about 42.5 % of the total European yield of cod.

For the Icelandic fishing industry, which in quantitative respect takes fourth place in the fisheries of European countries, the cod is of fundamental importance.

When outlining the biology of the cod in Icelandic waters we may emphasize: (a) that spawning takes place in the warm-water area between Lónsvík on the south-east coast and Snæfellsnes on the west coast, especially in April, although a less important spawning can also take place off other parts of the coast and at other times; (b) the eggs and larvae are carried with the residual current of the Gulf Stream from the spawning grounds to the west, north, and east coasts, where the larvae reach the bottom stage and spend the greater part of their first 6—8 years until maturity is reached; (c) the mature cod migrates to the spawning grounds and thence to the colder areas on the more northerly and easterly coasts in search of food, after spawning; (d) finally, it must be mentioned that cod larvae may be carried to Greenland, where they then grow up, and migration of ripe cod from Greenland to Iceland and of spent cod from Iceland to Greenland may take place on a considerable scale (TÅNING 1934). Some part of the cod taken in the Greenland fishery may thus be of Icelandic origin.

SCHMIDT has proved that spawning of cod takes place in Faxa Bay among other places, as mentioned above (SCHMIDT 1909). In April 1904 he

found drifting cod eggs at three places in the Bay (Chart IX, No. 1, St. 21—22—23) and later in the same year, in May—June, he found cod fry at all the places in the Bay (six in all) investigated with young-fish trawl. The greatest amount was found in the northern part of the Bay (St. 164), where 110 specimens were taken in a surface haul of only half an hour's duration. Later in the year no eggs or larvae were found. Although a large part of these eggs and larvae may have been carried into the Bay by currents, it is reasonable to assume that spawning of cod does take place here. Moreover this assumption is supported by experience from the fisheries. A great long-line fishery for spawning cod is carried out in the middle of the Bay from Akranes, especially over two areas situated as shown in Fig. 13, Paper 14. Another great fishing centre in the Bay, Keflavík, almost exclusively takes toll of fishing grounds outside the line we have pointed out as the boundary for the Bay on the side of the Atlantic Ocean, in the winter fishing for spawning cod. It is remembered from earlier years in this century and during the last decades of last century, that spawning cod were taken in considerable numbers in quite shallow waters only several fathoms from the shore at the inner part of the southern coast of the Bay. This fishery was carried on with nets, but has not taken place of late years.

At the end of the spawning season (May and onwards) the spent cod very often visit the Jökuldjúp in the northern part of the Bay, especially when following the great capelin shoals often present here at this time of the year. Then a considerable trawl-fishery for cod takes place here, by the Icelandic steam trawlers, but for the most part outside the line drawn between Malarrið and Gardskagi. Later on this fish migrates to the cold-water area.

Besides what has been mentioned here about spawning cod in Faxa Bay, immature cod are found in the Bay throughout the whole year, although in different numbers at different times and different places. This is exemplified in Table 29, where also the size distribution is shown. All the cod dealt with in the table were taken by me on the "Thor" with a seventy-five feet otter-trawl. The line drawn at 80 cm. in the table indicates the approximate size boundary between the mature and the immature cod. Firstly, we notice the presence of the I-group (10—20 cm.) in the Hvalfjörður where it makes up almost the whole stock, and in almost all the other places investigated there is a contingent of this group among older year-classes. From the quite young and small cod we have a size-range up to maturity in almost all parts of the Bay.

As to the importance of Faxa Bay for the Icelandic stock of cod these conclusions may be drawn, in accordance with what has been pointed out here:

1. Although the Bay cannot be regarded as an area of such outstanding importance as a spawning ground for cod, as for instance the waters off the south coast, it is of some importance for the spawning. 2. Owing to what we know of the frequency of young cod in the cold-water area of the north and east coasts we must admit that Faxa Bay is much inferior as a nursery ground, yet it seems to be of some value in this respect. 3. The growth-rate of cod in the Bay is much stronger than that in the colder waters, the cod growing up here reaching maturity at about six years of age as against eight to nine years for the east coast (SÆMUNDSSON 1923). 4. The conditions in the Bay as a nursery ground are extremely good owing to the rich bottom fauna and the great number of the lesser sandeel especially visiting the Bay in the summer and autumn months.

Table 29. Summary of Number and Size of Cod taken by "Thor" in Faxa Bay (See Fig. 12),

Season	May 1935 ¹		June ¹ 1936	June 1937		July 1936	October 1937					
St. No.	I	I	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Trawling hours cm.	7 ¹ / ₄	11	2	10	7 ¹ / ₃	11 ¹ / ₃	5 ⁵ / ₁₂	6	2	2	10 ¹ / ₂	13
125—129.....	—	—	—	—	—	—	—	—	—	—	1	—
120—124.....	—	—	—	—	—	—	—	—	—	—	—	1
115—119.....	—	—	—	—	—	—	—	—	—	—	—	3
110—114.....	—	—	—	—	—	—	—	—	—	—	—	12
105—109.....	—	—	—	1	—	—	—	—	—	—	—	15
100—104.....	2	1	—	1	—	—	—	—	—	—	1	26
95—99.....	1	1	—	3	—	2	—	—	—	1	2	13
90—94.....	6	9	—	11	—	—	—	—	—	—	2	21
85—89.....	10	9	—	10	12 not included	—	—	—	1	2	2	34
80—84.....	11	5	—	31		1	—	—	1	7	5	37
75—79.....	12	13	—	56		5	—	1	4	8	16	25
70—74.....	11	6	—	68	12 not included	4	—	1	8	8	24	31
65—69.....	19	13	—	72		7	—	4	7	6	30	31
60—64.....	13	20	—	91		30	—	1	21	4	33	13
55—59.....	12	26	—	65		18	—	3	15	—	18	14
50—54.....	7	13	—	77		57	1	1	11	2	6	5
45—49.....	9	32	—	121		63	1	1	9	1	1	5
40—44.....	10	73	—	107		54	5	1	7	—	3	9
35—39.....	16	84	—	219		18	4	—	7	1	4	9
30—34.....	16	52	—	146		2	—	—	1	—	37	30
25—29.....	9	10	1	57		—	1	—	—	—	42	26
20—24.....	—	—	—	5	1	—	—	—	—	—	5	2
15—19.....	—	—	33	1	1	—	—	—	—	—	—	—
10—14.....	—	—	6	—	—	—	—	—	—	—	—	—
Total	164	367	40	1,142	18	261	12	13	92	40	232	362
Per one tr. hour	23	33	20	114	2	196	29	2	46	20	22	28

¹ Herring trawl.

The Roman numbers in the above table refer to the localities given in Figure 12, next page.

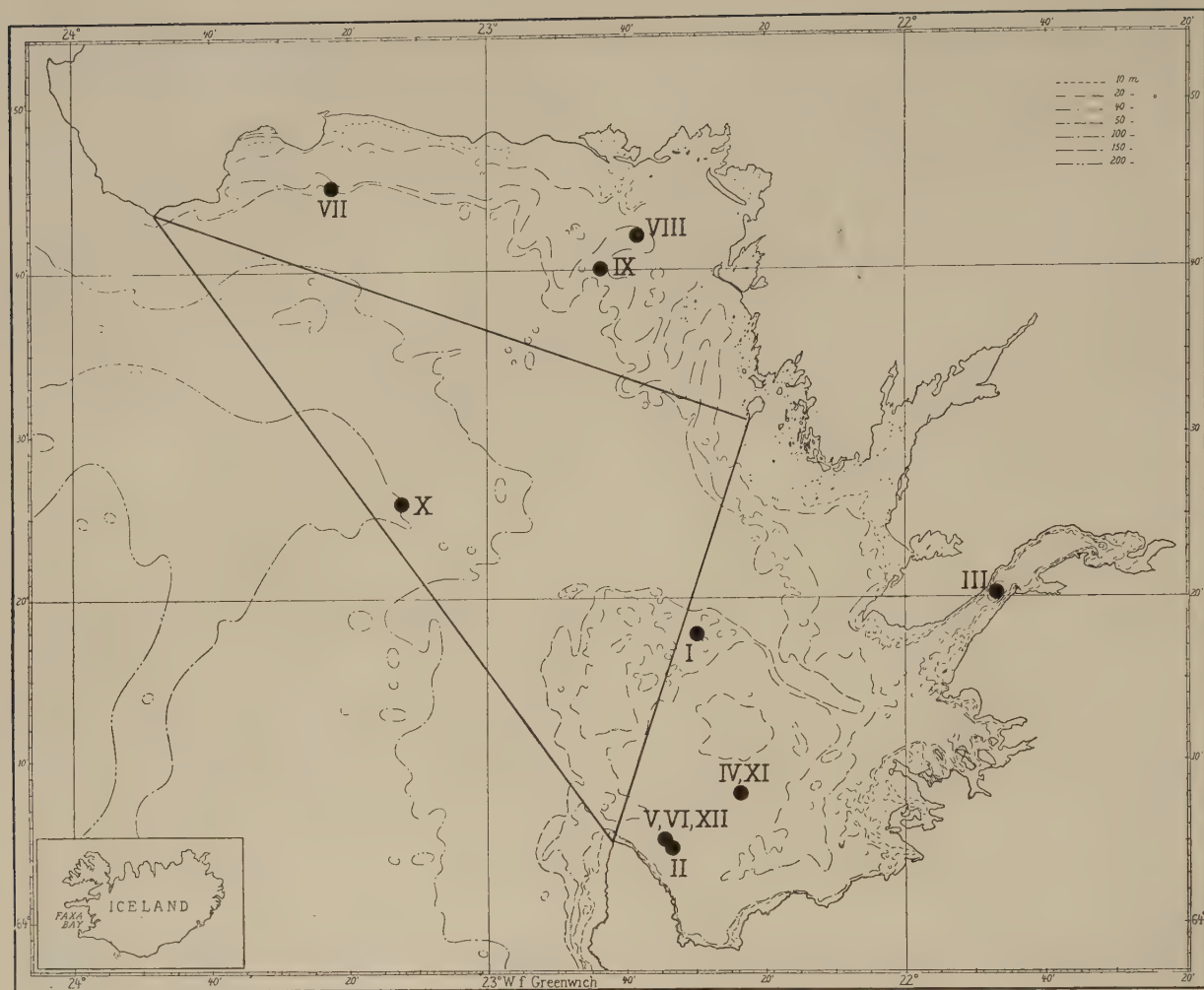


Fig. 12. Chart of Stations.

- I North of «Sydra Hraun» within the line Skagi-Hjörtsey.
- II In the «Gardssjór» on the territory between Keflavik and Skagi.
- III In Hvalfjörður.
- IV, XI The extraterritorial station in Sandaslód & Svidid.
- V, VI, XII Territorial station in Sandaslód & Svidid.
- VII In Budavik at Snæfellsjökull within the line Malarrif—Hjörtsey.
- VIII Territorial in Hafursfjörður, the north-east corner of the Bay.
- IX Extraterritorial in Hafursfjörður.
- X Jökuldjup. The middle of the Bay, just inside the line Skagi—Malarrif.

THE HISTORIC DEVELOPMENT OF THE FISHERIES IN FAXA BAY

BY

BJARNI SÆMUNDSSON †

As will be known to all dealing with the protection problem of Faxa Bay, Iceland became inhabited by the vikings in the latter half of the ninth century. Already in the year 874 the first viking-settlement in the new country was established by INGOLFUR ARNARSON, on the SE. corner of Faxa Bay, where he built the first farm in the new land and gave it the name of Reykjavík. On the very spot, where the farm of Ingólfur was situated, the capital of Iceland now spreads its numerous houses with their 36,000 inhabitants¹, over $\frac{1}{3}$ rd of the total population of the country.

As the vikings, familiar as they were with fishing and many of them experienced fishermen themselves, found the waters round the island, Faxa Bay included, teeming with valuable fish of the same kind as they were acquainted with at home, it was quite natural, that fishery became one of the principal modes of living of the people. The fisheries were, intelligibly enough, carried on with craft and fishing gear of the same kind as in the old country: open boats propelled by oars or primitive sails, the gear hand-line or short ground-lines, with few hooks, and small seines, all made of wool or any other adequate material.

With this primitive craft all the fisheries must originally have been carried out in inshore waters or in shallow waters in the vicinity of the coast, but as far as Faxa Bay is concerned, the above-mentioned shallow grounds farther out in the Bay, rich as they must have been in valuable fish, have assuredly soon become a great attraction for daring fishermen, in the more calm half of the year and spurred to use the sails more than the oars. Otherwise no essential changes took place in the fisheries of the Bay right down to the close of mediæval times, partially on account of the fact that foreign fishermen then first began to visit the Icelandic fishing grounds.

In the beginning of the 15th century British fishermen, as far as we know the first of foreign nations, began to visit the waters of Iceland, little by little followed by other nations, German, Dutch, French, and others, all to get their share of the enormous shoals of cod, in those times much liked as stockfish (dried); but few of their vessels visited the inner tracts of the Bay, fateful as it often has turned out for sailing craft, when S.—NW. gales suddenly spring up.

The Icelanders probably made their first acquaintance with the long-line from British fishermen, for already in the year 1699 the fishermen of Akranes (Faxa Bay) got the long-line prohibited as a dangerous gear for the stock of fish. Otherwise, the foreign fishermen seem to have had no further influence on the mind and habits of their Icelandic colleagues.

In the latter half of the 18th century, on the instigation of the Government, some experiments were made by the people of Faxa Bay with the curing of saltfish (Klipfisk) for export, with the use of better craft (Norwegian boats) and with nets for catching the cod. The new method of curing the cod became little by little common, whereas the use of cod-nets, regarded by the fishermen as having a great influence on the wanderings of the cod, was limited to the southern part of the Bay, right to the close of last century; then, after many restrictions on their use, they were finally introduced on the open SW. coast and on the Westman-Isles, where they have proved to be very advantageous.

As mentioned above, the fishing of the Icelanders was from the earliest times exclusively carried out in open boats. Not until the last decades of the 18th century and beginning of the 19th century were some experiments made by enterprising fishermen on the S. coast of Faxa Bay, who rigged out some decked boats, large enough for fishing on the more distant grounds in the Bay, or even outside it, in spring and summer; and later on, after the

¹ 1947 however 50 000.

middle of the century the vessels became larger, small schooners, built in Denmark, but few in number. In the "eighties", when the English began to discard the old beam-trawl ketches for modern steam-trawlers, the people at Faxa Bay got an unexpected windfall, being able to buy a great number of good craft at very low price and to fit them out for the cod-fishery, though for the most part outside the Bay. Some steam-liners were also bought.

Another circumstance of great importance on the Icelandic fishery in the Bay was the appearance of the steam-trawlers. About 1894 one or two British vessels visited the extraterritorial grounds and with such good results, that in the following years many of them exploited the grounds so thoroughly, that the Icelanders themselves, who from times immemorial had fished on them with their primitive gear, were now compelled to leave them to the benefit of the more powerful foreigners. Thus, seeing the livelihood of the poor local fishermen threatened, efforts were made to buy some small trawlers, which should work on the grounds fished by the foreigners, mostly British trawlers, in the hope that competition would drive them away; but the foreign trawlers were too numerous to be driven off by the Icelandic trawlers, which began to operate more and more on the extraterritorial deep-water grounds. But few of the Icelandic trawlers constantly fish in the Bay, where, like the foreigners, they are prohibited to fish inside the territorial limit.

Contemporaneously with the increase in the fleet of deep-sea trawlers at the two chief ports of the Bay (Reykjavík, the capital, and Hafnarfjörður), the old fleet of sailing ketches decreased and finally was sold to the Faroes or (the remaining vessels) provided with oil-motors. In like manner the old open boats disappeared and were succeeded by open or decked motor-boats.

It has been mentioned above, that only a few of the edible fishes of the Bay were originally recognized by the Icelanders. The most important of them all was the cod, the "fish", *kat' exochen*, which they cared most for; next to it

ranged, from a culinary point of view, the haddock, halibut, etc. The plaice and other small flatfishes and the "King Herring" himself were hardly known as edible fish before the end of the 18th century. Not until the close of the 19th century, when the Danes started a plaice fishery with the Danish seine in Icelandic fjords and the Englishmen used the otter-trawl, did the Faxa Bay fishermen gradually learn to esteem this fish, which they now catch in considerable quantities, in trawl and Danish seine, with steam-trawlers and motor-boats. Notwithstanding the fact, that the herring annually from earliest times filled the open waters and bays of their country (also the Faxa Bay), the Icelanders did not regard it as a fish of any value for human consumption before the middle of last century. First in the "sixties", when the Norwegians started their herring fisheries with large seines in the fjords of the E. and N. coasts, did the Icelanders in those areas begin to understand that the herring was of some value as a marketable fish, and then tried to partake in this new fishery on a small scale. For the fishermen of Faxa Bay the herring first became of value as bait for the cod, when the deep-water cod fishery had reached considerable height in the "eighties". Some herring were caught in simple ground-nets in shallow water in the southern part of the Bay, but in 1899 the first drifter was rigged out from Reykjavík for catching herring in the open sea in the outer part of the Bay (Jökuldjúp—Norður-Kantar) with quite promising results, and since then annually some herring fishery of this kind has been carried on in the Bay and on the grounds outside it, on an increasing scale, spring and autumn, especially in the last 2—3 years.

On the other hand, the Faxa Bay fishermen have always taken part in the drift fishery — and especially in the purse-seine fishery, which has developed to a really very imposing extent off North-Iceland.

The rather insignificant fishery on the Greenland shark, which was sought after on a small scale with sea-going boats or schooners from the harbours of the Bay during last century has quite come to an end, as everywhere in the island.

RECENT FISHING IN FAXA BAY

BY

ÁRNI FRIDRIKSSON

For the greatest part of the year an intensive fishery is carried out in Faxa Bay. Although any exhaustive statistics of the fisheries and the yields of the fisheries in the Bay in particular cannot be given we have two sources of information which shall be referred to here, viz.: (a) the number of fishing vessels operating in the Bay as described in the next paper (Paper 15) and (b) statistical information an outline of which is given in Paper 19.

At the present time we can divide the fisheries carried out in the Bay by the Icelanders themselves and by foreign nations into:

- I. Trawl fishing,
- II. Danish-seine fishing,
- III. Long-line fishing, and
- IV. Other fisheries.

I. The Trawl Fishing.

A rather large number of steam-trawlers from about 300 register tons and upwards seem to be working in the Bay throughout the year¹. A view of the number of trawlers in the Bay at different times of the year is given in Table 32, Paper 15, and in the Appendix to that paper.

Apparently we cannot see any pronounced difference in the intensity of trawling from month to month, at least such variation does not seem to run regularly. Though the number of vessels in the Bay appears to be a little less in the last two months of the year than in the remainder.

The proportion of nationalities of the trawlers operating in the Bay may be seen from Table 40, Paper 15 (and the Appendix). The great majority of the trawlers is British seconded by Iceland as number two. French and German trawlers use to frequent other parts of the coast, especially deep-water banks where great quantities of fish can be taken.

In the main it may be said that the British trawlers fishing in the Faxa Bay endeavour to get

¹ During the latest years motor-boats have commenced to operate with trawl in Icelandic waters, also in Faxa Bay (Author's note in 1947).

as much as possible of plaice, halibut, haddock and lemon sole, and obtain heterogeneous catches desirable for the British market. The same is true for the Icelandic trawlers that intend to land their catches in English harbours in late summer and autumn. They frequent the Bay for the same reason as the British trawlers. On the other hand, the Icelandic trawlers fishing for catches to be sold in Germany keep for the most part to the same grounds as are frequented by the German trawlers, i. e., off the south coast of Iceland and especially the deep-water banks off the north-west and east coasts, looking for coalfish and Norway haddock. Finally it must be pointed out that Icelandic trawlers are mainly working on deep-water grounds in the middle of the estuary of Faxa Bay also, and for the greater part outside the line Skagi-Malarrif, in the first six months of the year. In this fishery the general aim is large cod to be exported in a salted or dried state, so that the fishes most valuable later in the year, as for instance plaice, are of small interest.

II. The Danish-Seine Fishing

(See Fig. 13.)

This fishery is only carried out from small motor vessels, for the greater part by the Icelanders themselves, and has only been pursued in the Faxa Bay since about 1922.

As to the intensity of the Danish-seine fishery in Faxa Bay I do not think we shall be far wrong if we estimate the number of boats using this method whose home ports are in different harbours of Faxa Bay, as about 40. Yet it must be emphasized that some of these boats have been fishing outside Faxa Bay off other parts of the coast and as compensation we have had a number of visitors to the Bay from more distant ports (see Paper 22). Finally, it may be pointed out that practically all the Danish-seine fishery in Faxa Bay takes place in territorial waters, as the fishermen say they are disturbed by trawlers outside the line.

The figures in Table 30 have been compiled in order to give an idea of the composition of the catches from the southern part of the Bay (Area I) in September–October (1937) as to species, and the utility of the yields owing to size. Each of the three samples represents the total catch of a single one-hour haul. It is clear that the greater part of the cod has been thrown away and far more than half of the haddock is not marketable according to the size regulations (Paper 26). The size of the cod ranges from 20–62 cm. and that of the haddock from 22–45 cm. Only about one-fifth of the plaice was not marketable, the size ranging from 18–43 cm. All the whiting and dab were thrown away, although the size of the former was 23–36 cm. and that of the latter ranged from 12–33 cm. Finally, it must be mentioned that all the halibut were very small, the size being between 29 and 44 cm. In the three hauls 1,225 fish were caught, but only 222 were retained, the remainder, 1,003 fish, being rejected.

III. The Long-Line Fishing.

The third of the great fisheries carried out in Faxa Bay is the fishery with long-line.

The most important fishing ports situated on Faxa Bay are Gardur, Keflavík, and Njardvíkur on the south side, Hafnarfjörður at the south-east corner of the Bay, Reykjavík on the peninsula Seltjarnarnes, and Akranes on the northern side of Hvalfjörður. Among those stations Reykjavík and Hafnarfjörður are of special interest as homeports for trawlers and big line-fishing steamers.

The trawlings have already been mentioned and we can disregard the steam-liners here as they do, with few exceptions, fish outside the Bay proper. — The average number of motor-vessels operating longline from ports at Faxa Bay during recent years can be estimated as follows: 35–40 from Hafnarfjörður and Reykjavík, about 40 from Gardur, Keflavík, Njardvíkur and adjacent places, and 25–30 from Akranes; all these 100–110 vessels exceed 12 reg. tons. Of this number it may be said that practically only those from Akranes use to

fish in the Bay within the line Gardskagi—Malarif, the vessels from the other ports working outside this line. This is perhaps due to the depth conditions of the Bay; the Akranes vessels are not forced to go outside the line to find suitable places for fishing in the winter season, because they can reach the innermost part of the Jökuldjup in the middle of the Bay. According to information received from the fishermen there seem to be two general fishing localities for the boats from Akranes, as shown on Fig. 13. These grounds are simultaneously frequented by the fishermen, i. e., the small boats fish on the innermost grounds and the larger on the grounds farther out which extend partly out of the Bay.

In addition to what has been said above we must mention that in Akranes, Reykjavík, and Hafnarfjörður a number of smaller boats go out with long-lines when the weather conditions are favourable, and besides that the Bay, especially the northernmost part of it, is the basis of operations for long-line fishing vessels from harbours outside the Bay, mainly Isafjörður (N. W. Iceland). As compensation it must be pointed out that some of the bigger boats from Akranes may occasionally seek the fishing grounds outside the Bay.

The long-line fishery as carried on in Faxa Bay is a typical cod fishery. By far the most important species of fish is the cod, especially the ripe, spawning and spent cod, whereas smaller immature cod may make up a relatively small amount of the catches, viz., up to 10 to 20 % numerically (see Paper 23). Most of the cod have been cured as “klipfisk” (salted and dried cod) for export. In addition to the cod a very much smaller amount of large haddock and large coal fish and ling are taken in this fishing. Other species may be regarded as irregular in the catches, e. g. halibut, catfish, torsk, and blue ling. The long-line fishing begins in Jan./Feb. when the ripe cod are entering the spawning grounds, reaches its maximum in late March/middle of April, and ends towards the middle of May when the spawning has ceased and the larger cod have left the banks. Some vessels may, however, continue the fishing until June, or

Table 30. Composition of three Danish-Seine Catches in Faxa Bay.

Species	Sept. 18th		Sept. 20th		Oct. 2nd		Total	
	Retained	Rejected	Retained	Rejected	Retained	Rejected	Retained	Rejected
<i>Gad. call.</i>	—	10	1	11	15	—	16	21
<i>Gad. øglef.</i>	4	36	25	5	25	28	54	69
<i>Gad. merl.</i>	—	8	—	10	—	5	—	23
<i>Pleur. plat.</i>	104	34	11	2	21	—	136	36
<i>Pleur. lim.</i>	—	721	—	98	—	11	—	830
<i>Pleur. micr.</i>	2	1	2	1	—	—	4	2
<i>Drepanopsetta</i>	—	15	—	1	—	—	—	16
<i>Hippogl. vulg.</i>	2	—	10	—	—	—	12	—
<i>Loph. pisc.</i>	—	—	—	1	—	—	—	1
<i>Raja radiata</i>	—	5	—	—	—	—	—	5
Total	112	830	49	129	61	44	222	1,003

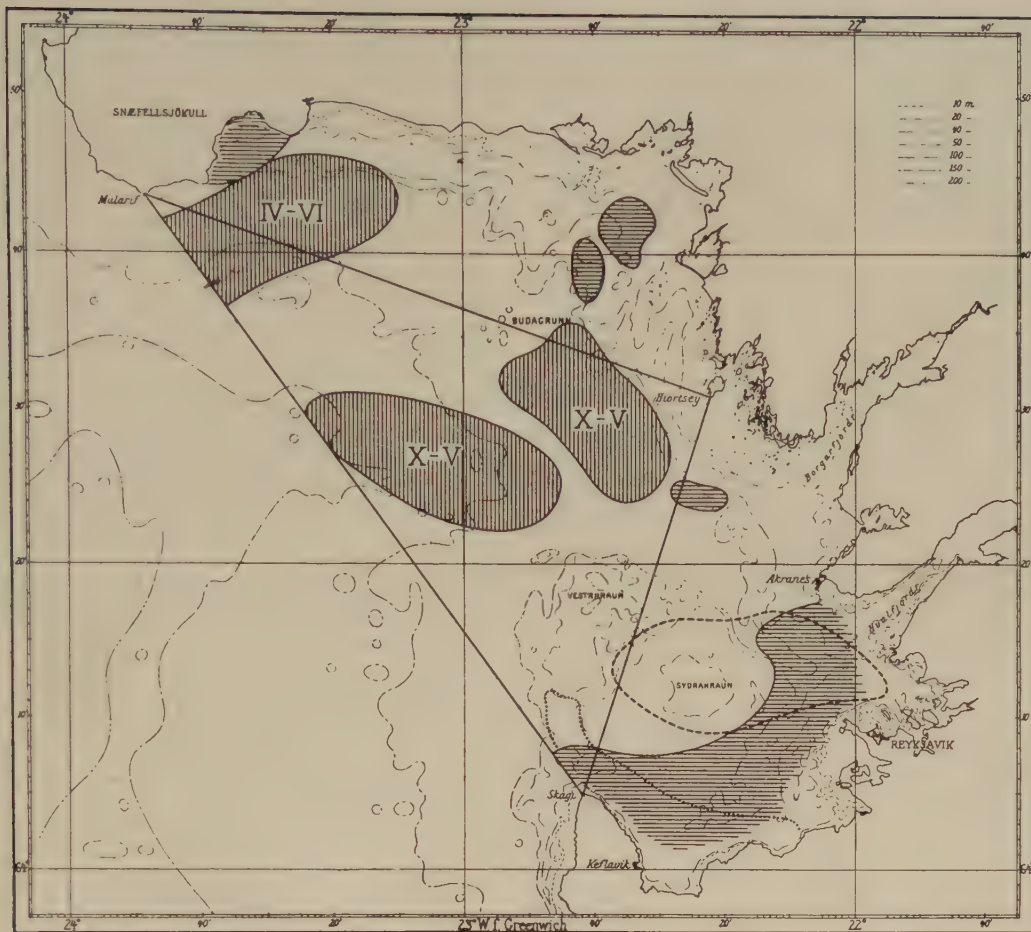


Fig. 13. Fishing Grounds frequented by Icelanders (exclusive of trawlers). Sketch chart.

Horizontal hatching:	Danish-seine fishing.
Vertical	Long-lines; IV-VI etc. = months.
Dotted line:	Cod-net fishing.
Broken line:	Hand-line fishing from Reykjavík.

perhaps the beginning of July, but the majority commence the Danish-seine fishing when the territorial grounds are opened for this type of fishing, and when we approach the end of June the great herring fishery of the north coast of Iceland attracts them. Long-line fishing in Faxa Bay during other months is negligible.

The total annual weight of the catch brought ashore from the vessels in Faxa Bay may be estimated to range between 15—20 thousand tons.

As the fishing methods with long-line in Faxa Bay do not differ from those used off the other coasts of Iceland and in other countries, they will not be described here. It may only be mentioned that the bait used is frozen herring, the number of

hooks usually varies between five and ten thousand and the boats as a rule leave harbour in the small hours of the morning and return in the afternoon.

IV. Other Fisheries.

Now that we have dealt with the three most important types of fishing in Faxa Bay in modern times, we will conclude by mentioning a few fishing methods of inferior importance. Among these is the cod fishery by means of stand-nets. This fishing method was more generally used formerly than it is now, when it is only carried out on a small scale from Njardvíkur and Keflavík.

It is a typical large-cod fishery, although a small number of large coalfish may also be taken occasionally. It takes place during the proper spawning season, from the middle of March to the end of April. The fishing grounds are partly outside the line Gardskagi—Malarrif, partly inside, occasionally extending far along the south coast of the Bay into quite shallow waters where the cod may pursue large shoals of capelin. The number of vessels engaged in this fishery may be estimated as 8—10.

Another still less important cod fishery of this kind may take place from the end of August and last several weeks, when large cod happen to come into the more southerly parts of the Bay pursuing the lesser sandeel (*Ammodytes lancea*).

In the last century and in the first years of the present a considerable hand-line fishery was carried out in Faxa Bay, partly by Icelanders and partly by foreigners. But as the fishing industry has become more and more mechanised this fishery has now ceased. Only during the summer months a few boats may work with hand-lines in the coastal waters near Reykjavík, but this may be regarded rather as a sport than as serious fishing.

In the *Laminaria* zone near shore some lump-sucker fishery is carried on at several places in Faxa Bay during the summer months. The number caught per annum may vary between 50 and 100 thousand, the tackle used being stand-nets. Every now and then a small amount of young herring and quite young coalfish are caught by means of a circle-net especially in Hafnarfjörður. On the other hand the fishing of large herring, exclusively carried on by means of drift-nets during the late summer and autumn months, takes place almost entirely outside the line limiting the Bay¹. Finally some large herring fishery of very little importance may occasionally take place with stand-nets in Keflavík. It must also be mentioned, that some of the richest salmon and trout rivers have their outlets in Faxa Bay and offer great opportunities for sport to the Icelanders themselves as well as to British anglers. The fishing of salmon and trout in the sea is forbidden.

¹ A large-scale herring fishery took place in the Fjords of the Bay during the winter of 1946—47 and again during the autumn of 1947 (Author's note 1947).

NUMBER OF FISHING VESSELS AT ICELAND, ESPECIALLY IN FAXA BAY ACCORDING TO OBSERVATIONS OF PATROL BOATS

BY

ÁRNI FRÍÐRIKSSON

I. Introduction.

For many years Danish and Icelandic fishery patrol vessels have made observations in Icelandic waters as to presence and number of fishing vessels. Here we are going to deal with that part of the material which has been collected and treated. It must be kept in mind, that the best patrol-ship records are those that deal with fishing vessels not admitted to operate on the territory, viz., the trawlers and the seine-netting boats, except the Icelandic and Danish ones, in periods when fishing within the territorial limit is allowed. All the figures given in this paper must be regarded as minimal figures as obviously many vessels must have escaped observation. This is chiefly the case as regards vessels that are allowed to fish on the territory; accordingly we get the best information about the trawlers.

The material treated here deals with two periods: 1927—1937 and 1904—1906. The records from the latter period are exclusively collected by Danish vessels whereas the former originates from Danish as well as Icelandic patrol boats. The Icelandic material (1929—37) and the data from 1904—06 cover the entire Icelandic waters, while the Danish observations for the period 1927—37 have been treated in respect of the Faxa Bay only.

In many cases the position, nationality, number of observed vessels etc. are uncertain. These cases are omitted here or dealt with specially, as will be seen in the following.

In order to get a clear understanding as to the relative number of fishing vessels and the intensity of the fishery off the different parts of the coast, the waters round Iceland have been divided into the areas 1 to 8 as shown in Fig. 14.

As regards the Faxa Bay area, this has been divided into 4 sub-areas, as follows:

Sub-area IV: The area West of a line from Gardskagi in S. to Malarrið in N., or outside the Faxa Bay proper. Inside this line we have:

Sub-area I: East of a line from Gardskagi to Hjörsey,

Sub-area III: North of a line from Hjörsey to Malarrið and

Sub-area II: The central part of the bay between the three other sub-areas.

Extracting from the log-books the number of days of observation within each area, the number of fishing vessels arranged according to gear etc., it will be possible to calculate the average number of fishing vessels per 10 days, and thus to compare the intensity of the different fishing gears used within each locality from month to month throughout the year. In this connexion it must be remembered, that the same patrol vessel may very well make observations in different areas in one day, but in the tables a single working day will record just as many days of observation as the number of areas visited.



Fig. 14. The different Areas into which the Waters round Iceland are divided.

1. The Faxa Bay area between the latitudes of Öndverðanes and Gardskagi.
2. The Breidafjörður area, between the latitudes of Öndverðanes and Látrabjarg.
3. The NW. coast area, between the Látrabjarg latitude and Straumnes-NW.
4. The N. coast area, between Straumnes NW. and Langanes NE.
5. The E. coast area, between Langanes NE. and Eystra Horn SE.
6. The eastern S. coast area from Eystra Horn SE. to Portland S.
7. The western S. coast area from Portland S. to Reykjanes SW, and
8. The Midneshjór-area, from Reykjanes SW. to the Gardskagi latitude.

Table 31. Days of Observations in the Years 1929—1937 according to Areas and Months.
(Icelandic Observations only).

	Faxa B.	Breida B.	NW.	N.	E.	SE.	Westm.	Reykj.	
Area	1	2	3	4	5	6	7	8	Total
Month									
Jan...	56	38	69	23	4	16	47	37	290
Febr.....	43	15	11	11	2	20	59	35	196
March....	45	18	13	4	1	54	156	54	345
Apr.....	40	10	11	3	5	37	124	41	271
May.....	32	8	7	10	6	47	47	12	169
June.....	19	7	13	17	12	33	34	5	140
July.....	17	6	13	56	14	11	16	9	142
August....	24	14	17	113	38	21	19	11	257
Sept.....	32	24	36	58	35	14	16	11	226
Oct.....	66	29	44	51	39	28	49	26	332
Nov.....	46	27	36	29	16	19	32	21	226
Dec.....	63	36	61	19	5	8	23	29	224
Total	483	232	331	394	177	308	622	291	2,838
Mean	40	19	28	33	15	26	52	24	237

II. The Number of Vessels observed in the Different Areas in Recent Years.

From the material collected by the two Icelandic patrol vessels: "Thor" and "Ægir", we are able to compare the number of vessels observed at different parts of the Icelandic coast during the years 1929—1937. The number of days of observation totals 2,838 in all areas including 483 days in the Faxa Bay (See Table 31). Some areas are better covered by observations than others and the total number of vessels observed, therefore, can give no true picture of the relative importance of the different areas. In order to get a reliable picture of the numbers for comparison from area to area and from month to month the average number of steam-

trawlers observed per ten days has been recorded in Table 32 (see the footnote).

This table clearly indicates the importance of the different areas at various trawling seasons, in so far as the number of trawlers is able to do so. Thus, in January area 3 seems to be preferred (82 per 10 days) while in February area 8 records the highest figure (121). In March area 7 is of greatest importance (142) followed by area 8 (93). In the main spawning month for the cod, April, we find the greatest density of trawlers off the S.-coast in areas 6 (115) and 7 (100), decreasing westward through area 8 (90) to 1 — Faxa Bay — where the

Table 32. Average Number of Trawlers observed per 10 Days.¹
(Icelandic observations only).

	Faxa B.	Breida B.	NW.	N.	E.	SE.	Westm.	Reykj.	Monthly distribution
Area	1	2	3	4	5	6	7	8	of fishing intensity.
Month									
Jan.....	40	37	82	30	20	58	51	60	7.4
Febr....	91	70	43	19	25	50	88	121	11.3
March..	79	78	25	7	20	55	142	93	14.2
April...	59	30	24	20	6	115	100	90	11.8
May....	73	44	29	53	60	149	86	74	12.8
June....	39	27	32	57	9	92	41	18	6.8
July....	49	57	35	23	41	177	54	27	6.3
August..	40	30	56	21	60	46	46	21	4.8
Sept....	47	57	52	38	52	49	29	26	6.3
Oct.....	45	34	67	39	49	59	38	28	6.3
Nov.....	37	37	65	38	11	33	44	30	5.5
Dec.....	42	45	68	34	30	44	36	38	6.5
Areal distribution of fishing intensity	11.3	9.6	13.0	6.6	9.6	17.7	18.2	14.0	100 %

¹ 10 day × 12 months × 8 areas gives 960 days of observations. The actual number of observation-days, however, totals 2838.

number is still as high as 59. During the summer months May—July the area 6 maintains a superior concentration of trawlers, seconded by area 7 in May, the N. coast (4) in June, and the areas 2 and 7 in July. During August, the E. coast seems to be of the greatest importance, while in September we find the greatest number of trawlers in area 2, as a forerunner of the marked concentration in the NW. area (3) from October to January. The movement of these concentrations from month to month seems to correspond with the life-history of the food-fishes in general, viz., spawning migrations into southern and warmer waters in winter and emigrations for food in summer and autumn to colder waters.

The area percentage-mean of all months shows the superiority of area 7, closely followed by area 6 (18.2 % and 17.7 % resp.) and with area 8 third (14.0 %) — or 50 % between Eystra Horn and Gardskagi. Next comes the NW. coast (area 3) with 13.0 % and Faxa Bay (1) with 11.3 %. Breidafjord and the E. coast areas (2 and 5) stand equal with 9.6 %, while the N. coast area (4) is that most sparsely visited — 6.6 %.

The figures in Table 32 thus give a fair idea of the relative importance of the different areas from month to month; but as the patrol vessels preferably move along the territory, trawlers working far from the coast might have escaped the records. Further it should be remembered that the figures, given in the table, indicate all trawlers observed whether fishing or not.

For the purpose of this report the area I is of special interest, and in particular the Faxa Bay

proper — the area east of the line Gardskagi—Malarrif. It would be of value to know the relative importance of all kinds of fishing gears employed in the bay, but the information we possess as to the number of line- and net-fishing vessels is rather incomplete, as the numbers given by the patrol vessels make no claim on being complete for this kind of gear. With all reservations Table 33 indicates the relative number of different fishing vessels observed in the Faxa Bay proper (Sub-areas I—III) arranged monthly as percentage of the total number recorded in all Icelandic waters at the corresponding periods. Out of 100 trawlers working in Icelandic waters in January 3.3 only are recorded in the Faxa Bay proper, at the same time we find 24.2 % of the long-line steamers in the bay, 52.2 % of the motor-boats fishing with long-line, and no other gear employed. It will be seen later that the high percentage of long-line vessels in the bay is due to relatively small fishing activities in all other areas early in the year. The February picture is very much like that of January. The table indicates that the relative importance of the bay to other areas is subject to great variations throughout the year.

The last column of the table gives some idea of the relative importance of the bay to the entire fishery, calculated as means for the whole year, but, as already emphasized the figures indicating the number of line and seine-net vessels should be used with caution. The figures in the last column show that out of 100 trawlers fishing at Iceland throughout the year, we find 7.1 in the Faxa Bay proper; out of 100 long-line steamers we find 12.8 there, etc.

Table 33. Average Number of Different Fishing Vessels observed in the Faxa Bay Proper, in Percentage of the Total Number of Vessels observed in all Icelandic Areas in each Month.

(Icelandic observations only).

Vessel:	Month: Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
Trawlers.....	3.3	3.9	3.6	13.2	10.9	7.7	7.4	8.8	12.5	9.5	9.0	5.2	7.1
Longl.-steam.....	24.2	32.8	9.6	14.4	11.8	0.0	0.0	0.0	7.7	0.0	16.7	24.4	12.8
Longl.-motorb.....	52.2	34.8	4.3	18.5	40.7	24.1	0.0	0.0	23.0	7.4	20.0	6.6	14.1
Handl.-vessels.....	0.0	0.0	4.2	28.0	6.1	0.0	0.0	0.0	0.0	20.0	0.0	0.0	9.3
Dan.seine-b.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	22.8	30.8	33.5	0.0	12.9
Driftn.-boats.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	17.1	0.0	0.0	12.4
Whal. vessels.....	0.0	0.0	0.0	0.0	0.0	0.0	75.0	27.4	54.4	25.0	0.0	0.0	41.5

III. The Recent Fishery in the Faxa Bay Proper.

Above it has been tried to estimate the importance of the area I in relation to all Icelandic waters. This comparison was based on a total of 2,838 days of observation, with 483 in the area I. In the Faxa Bay proper, as defined above: East of the Gardskagi—Malarrif line material exists for 300 days only.

Dealing with the Faxa Bay proper, divided into sub-areas I—III, the figures of the rather scanty

material above (about 300 days of observation) do not suffice, and the observations from Danish vessels dealing with the Faxa Bay are therefore included (See Table 34). In Table 35 the number of days of observation is recorded by sub-areas and by months. A total of 880 days of observation is distributed as follows: 575 in sub-area I, 293 in II but 12 only in III. In Table 36 the number of different kinds of fishing vessels have been cal-

Table 34. Patrol Vessels from which Material has been treated.

A = Material from all Areas, F = from the Faxa Bay only.

Years	Danish patrol vessels					Icelandic patrol vessels		
	Hekla	Isl. Falk.	Fylla	Hvidbj.	Maag.	Ægir	Thor	Gautur
1904	A	—	—	—	—	—	—	—
1905	A	—	—	—	—	—	—	—
1906	—	A	—	—	—	—	—	—
1927	—	F	—	—	—	—	—	—
1928	—	F	F	—	—	—	—	—
1929	—	—	F	F	—	A	—	—
1930	—	—	F	—	—	A	—	—
1931	—	—	F	F	—	A	A	—
1932	—	—	F	F	—	A	A	—
1933	—	—	F	F	F	A	A	—
1934	—	—	—	F	—	A	A	—
1935	—	—	—	F	—	A	A	—
1936	—	—	—	F	—	A	A	—
1937	—	—	—	F	—	A	A	A



culated as average 10-day observations, per month and per area.

Omitting the pelagic fishery, 4 kinds of fishing gear are employed in Faxa Bay proper; trawl, seine-net, long-line and hand-line. The number of trawlers working in the bay varies from 54 in January up to 118 in October as average per 10-day observations. The greatest number of trawlers is recorded in: February (and March) 101, (probably fishing mature cod), in May 105 when the cod is migrating from the spawning grounds in the south to the cold-water areas and when plaice is moving towards the coastal banks, and finally in October (plaice and haddock fishing) 118, the maximum of the whole year. The average number of trawlers seen in the bay per 10 days throughout the year is 88, or some 9 trawlers recorded per day. The table also proves that the different sub-areas are of highly different interest to the trawlers working in the bay. Sub-areas I and II, with 43.2 % and 46.9 % respectively against 9.9 % only in III. This may partly be due to the bottom conditions, the greatest part of sub-area III having a very hard bottom or sand bottom, whereas the bottom in I in particular but also in II for the greatest part is covered with soft deposits. According to the table the Danish-seine vessels are present in the spring but mainly working the bay in the autumn (Sept.—Nov.) when up to 21 vessels are recorded per 10-day observations. Like the trawl the Danish-seine fishery is almost exclusively limited to the soft-bottom grounds in sub-area I, where 93 % of all seine-netting in the bay takes place, the remainder being carried out in II, whereas no seine-netting vessels have been observed in sub-area III.

Fig. 15. Number of different Fishing Vessels in the Faxa Bay proper calculated as average per 10-day Observations during 1927—1937.

Table 35. Number of Days of Observations in the Faxa Bay Proper during 1929-1937.

(Icelandic and Danish observations).

Sub-Area:	Jan.	Febr.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
I	24	34	50	66	71	40	35	38	65	73	45	34	575
II	12	23	44	25	28	25	15	22	34	28	25	12	293
III	—	—	5	—	1	—	—	1	1	2+	1	1	12
Total:	36	57	99	91	100	65	50	61	100	103+	71	47	880

While the otter-trawl and the Danish seine are gears that catch all sorts of fish the long-line is mainly fit for catching "cod fishes" (Gadidae) and a few other species of larger fish. Thus we find the long-line steamers in the bay chiefly concentrated on periods in which the cod is immigrating, actually spawning and again emigrating as spent. The most important months for the line-fishing in the Faxa Bay therefore are February—June, when the number of line steamers rises from 38 in February to 47 in April and decreases to 30 in June as averages per 10-days observation. Most important to the long-line steamers is the sub-area I with II as a close second, whereas III apparently is of little value, the percentage numbers in Table 36 being 54.8 %, 45.2 % and 0.0 % respectively.

Similar considerations are valid in the motor-vessel line-fishery, a spring season fishery specially concentrating on sub-area II (76.1 %), while no vessels have been observed in III.

As regards the hand-line fishing the result is very similar to the long-line fishery. This

gear is specially suited for a spring fishery, and about 73 % are recorded in May. The total number of hand-line vessels is distributed by 16.5 % in the sub-area I, 11.5 % in II and 72.0 % in III.

In summarizing the above figures for the Faxa Bay proper we arrive at the following result per 10-days observation:

88 steam-trawlers or	69,7 %
4 Danish-seine vessels or	2,8 %
21 long-line vessels or	16,4 %
14 hand-line vessels or	11,1 %
127 vessels	100,0 %

An experimental closure of this Bay is intended to protect the plaice, the halibut and the haddock. One question is, whether the protection of these three species would be effective if 92 vessels, or 72.5 % of all vessels fishing in the bay, (trawlers and all seine-net vessels) were excluded, while 35 vessels (27.5 %) were allowed to continue the fishing. In

Table 36. The Fishery in the Faxa Bay Proper during the Years 1927-1937. Number of Fishing Vessels as Average 10-day Observations per Area¹ and per Month.

(Icelandic and Danish observations)

Month:	Trawlers				Dan.-Seine vessels				Longl. steamers				Longl. motorvess.				Handline vessels.			
	I	II	III	Total	I	II	III	Total	I	II	III	Total	I	II	III	Total	I	II	III	Total
January	25	29	—	54	0	0	—	0	1	3	—	4	0	4	—	4	0	0	—	0
Febr. . .	51	50	—	101	2	3	—	5	23	15	—	38	0	19	—	19	2	0	—	2
March . .	21	60	14	95	0	0	0	0	26	11	0	37	1	5	0	6	2	2	2	6
April . .	46	31	—	77	0	0	—	0	17	30	—	47	4	2	—	6	13	12	—	25
May . . .	48	57	0	105	0	0	0	0	10	30	0	40	0	4	0	4	3	1	120	124
June . . .	42	30	—	72	0	0	—	0	30	0	—	30	0	0	—	0	1	0	—	1
July . . .	39	55	—	94	0	0	—	0	0	0	—	0	0	0	—	0	2	0	—	2
August . .	33	27	30	90	1	0	0	1	1	0	0	1	0	0	0	0	4	2	0	6
Sept. . . .	41	34	0	75	21	0	0	21	4	3	0	7	3	1	0	4	1	2	0	3
Oct. . . .	42	46	30	118	3	0	0	3	0	0	0	0	1	0	0	1	0	0	0	0
Nov. . . .	32	44	20	96	13	0	0	13	0	0	0	0	2	0	0	2	0	0	0	0
Dec. . . .	37	32	10	79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total . .	457	495	104	1,056	40	3	0	43	112	92	0	204	11	35	0	46	28	19	122	169
Mean . . .	38	41	9	88	3	+	0	4	9	8	0	17	1	3	0	4	2	2	10	14
%	43.2	46.9	9.9	100	93	7	0.0	100	54.8	45.2	0.0	100	23.9	76.1	0.0	100	16.5	11.5	72	100
Total	1,056				43				204				46				169			
%	69.7				2.8				13.4				3.0				11.1			

¹ I = south, II = central, III = north

order to solve this problem some figures from the Icelandic statistics in 1936 may be helpful:

Catch by:	Haddock tons	Plaice tons	Halibut tons
38 trawlers.....	1,162	658	149
316 other vessels ¹	862	540	110
710 motor-boats ²	918	0	58
Average catch per vessel:			
trawlers	30.6	17.3	3.9
other vessels.....	2.7	1.7	0.4
boats.....	1.3	0.0	0.1

¹ Larger than 12 brutto register tons,

² Less than 12 » » »

Assuming (a) that the English trawlers catch more haddock, plaice and halibut per vessel than the Icelandic ones (the latter being engaged in a special cod-fishery for the klipfish curing in the spring and herring fishery in the summer) (b) that the greatest part of the three above-mentioned species, especially as regards the plaice, caught by "other" vessels and motor-boats are caught by the Danish seine, and finally (c) that the seine-net vessels should be excluded from the bay like the trawlers, it seems justified to state that the stock

of haddock, plaice and halibut in the bay would be protected with close on 100 % effectivity. We can make the calculation as to the effectivity of protection in a very simple way. In the case of the haddock, we find that 69.7 trawlers catch 30.6 tons on an average or 2,132.82 tons in all. Assumed that the number of boats equals the number of "other vessels", the average catch of those vessels will be $2.7 + 1.3$ divided by $2 = 2$ tons. Then we also assume for the sake of simplicity that all these vessels were fishing with Danish seine. We find that 2.8 vessels take 5.60 ton, so that $2,132.82 + 5.60 = 2,138.42$ tons of haddock are saved, if we close the bay for trawling and seine-netting. On the other hand, the remaining 27.5 vessels taking 2 tons in average will get 55 tons, so that the effectivity of the protection as regards the haddock will be 97.5 %. In the same manner we find that the effectivity as regards the plaice will be 97.8 % and 97.4 % for the halibut. All these numbers are of course approximate only, but they are minima, because the fishing capacity of the remaining vessels has been put equal to that of the seine-net vessels.

Applying the Iceland figures to the above summary of vessels fishing in the Faxa Bay proper, we get the figures given in Table 37.

Table 37.

		Haddock		Plaice		Halibut	
		each	all	each	all	each	all
1) Trawlers	(69.7 %)	30.6 t.	2,132.82 t.	17.3 t.	529.4 t.	3.9 t.	119.3 t.
2) Danish-seiners	(2.8 %)	2.0 »	5.60 »	1.7 »	4.8 »	0.4 »	1.1 »
3) Long-liners	(16.4 %)	2.0 »	32.80 »	—	—	—	6.6 »
4) Hand-liners	(11.1 %)	2.0 »	22.20 »	—	—	—	1.1 »
1) + 2)			2,138.42 t.		534.2 t.		120.4 t.
			97.5 %		100 %		94 %
3) + 4)			55.00 t.		—		7.7 t.
			2.5 %		0 %		6 %

Table 38. The Fishery in the Faxa Bay Proper during the Period 1904—1906. Average Number of Fishing Vessels per 10-day Observation in each Area.

(Danish observations)

Month:	Number of days of observations.				Trawlers				Long-line vessels				Handline vessels			
	I	II	III	Total	I	II	III	Total	I	II	III	Total	I	II	III	Total
March...	1	1	—	2	10	0	?	10	0	0	?	0	0	10	?	10
April...	5	1	—	6	32	0	?	32	0	0	?	0	6	90	?	96
May.....	13	2	—	15	90	0	?	90	1	0	?	1	13	45	?	58
June.....	17	3	1	21	49	87	130	266	14	0	0	14	2	7	0	9
July.....	6	5	—	11	65	50	?	115	17	0	?	17	0	4	?	4
August...	6	4	—	10	33	20	?	53	0	10	?	10	0	0	?	0
Sept.....	7	0	—	7	66	?	?	66	0	?	?	0	0	?	?	0
Oct.....	9	1	—	10	49	10	?	59	0	0	?	0	0	0	?	0
Nov.....	8	0	—	8	31	?	?	31	0	?	?	0	0	?	?	0
Total	72	17	1	90	425	167	130	722	32	10	0	42	21	156	0	177
Mean 10 days					47	19	14	80	4	1	0	5	2	17	0	19
%					58.7	23.8	17.5	100	80	20	0.0	100	10.5	89.5	0.0	100
Total					722				42				177			
%					76.7				4.5				18.8			

IV. The Fishery in Faxa Bay, 1904—1906, as compared with the recent Period 1927—1937.

Some records on the number of fishing vessels, observed by Danish patrol vessels in the bay 1904—1906 (Table 34) are available. Although the material is rather scanty it may be sufficient for comparing the fisheries in the bay then and now. The observations cover the months March—November, incl., and the number of days amounts to 90, distributed (Table 38) as 72 in area I, 17 in II and 1 only in III.

As regards the trawlers it appears that (a) the number of trawlers has been about the same as now, or slightly less, 80 against 88 per 10 days; (b) that trawling in the bay was restricted to certain seasons, chiefly May—July, unlike recent years' more evenly distributed fishing throughout the year (cf. Table 36). Undoubtedly this typical summer-

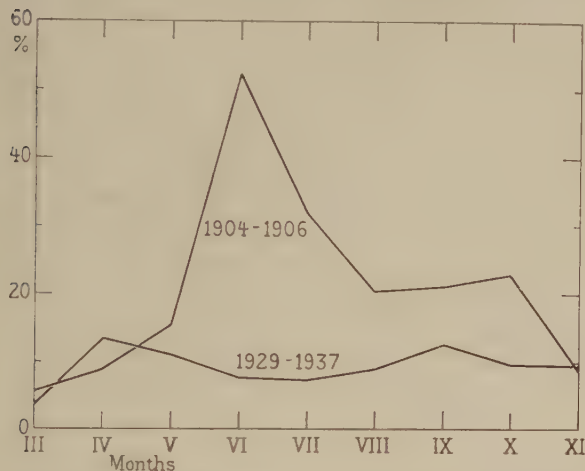


Fig. 16. Relative Number of Steam Trawlers in Faxa Bay in Percentages of all Trawlers observed at Iceland in the Periods 1904—1906 and 1929—1937.

fishery was based upon a greater quantity of haddock, plaice and halibut than now occurring; (c) that area I appears of greater importance than now (58.7 % against 43.2 %) as also area III (17.5 % against 9.9 %), a percentage, however, based on a single observation only (in June).

In this period there was no Danish-seine fishery in the Faxa Bay and the long-line fishery was less developed than now, and mainly concentrated to the summer months, especially June—August. No more than 5 long-line vessels were observed (average per 10-day observation) throughout the year as against 21 (steamers and motor-boats) in recent years. As to area III long-line fishing has not been recorded in either period; area I seems superior to II, 80 % v. 20 % respectively in 1904—1906, as against 50 % in each of these areas in 1927—1937.

Finally, the decrease in hand-line records: 19 against 14 in recent years, agrees well with the fact that the hand-line fishery from French and Icelandic vessels has meanwhile ceased. The hand-line fishery took place as to-day, in the spring (April—May), and was based upon mature, spawning and spent cod. The most important area for this fishery seems to have been area II (89.5 %) whereas area III is of greatest value (72.0 %, Table 36) to-day.

According to the number of vessels recorded the Faxa Bay then seems to have been of relatively greater importance to the trawling than to other fisheries.

In 1904—06 76.7 % trawlers and 23.3 % other vessels. In 1927—37 69.7 % trawlers and 30.3 % other vessels.

This phenomenon may be explained by decrease in stock of species especially fished upon by the trawlers.

Table 39. Number of Trawlers in Faxa Bay in March—Nov., 1904—1906 and 1927—1937, and the corresponding Percentages of all Trawlers recorded in Icelandic waters.

Month:	Numbers in the bay (10-day means)		Percentage of all waters.	
	1904—1906	1927—1937	1904—1906	1927—1937
March ...	10	95	5.7	3.6
April....	32	77	8.5	13.2
May.....	90	105	15.4	10.9
June.....	266	72	52.0	7.7
July.....	115	94	32.0	7.4
August...	53	90	20.1	8.8
September	66	75	20.7	12.5
October..	59	118	22.4	9.5
November	31	96	8.4	9.0
Average.	80	91	20.6	9.2

Of special interest is the relation between trawling in the bay and that in all Icelandic waters. The records permit such comparison for all months, except January, February and December, and Table 39 and Fig. 16 illustrate the relationship fairly well.

The table confirms the seasonal character of the trawling in the early period and the more even distribution to-day, as well as a slight increase in intensity (91 against 80 for the months III—XI, but 88—80 for all the year). Finally the table records a decline from about 20 % to less than 10 % of all trawlers working at Iceland in Faxa Bay, a phenomenon to some extent explainable by decreasing stocks of food-fishes, plaice etc., specially caught by the trawlers. Based on

records available Fig. 17 shows that the fishing in the Faxa Bay area concentrated on shallow waters at the beginning of this century, e. g., that most trawlers are recorded within the line Gardskagi—Malarrif or in the Faxa Bay proper, while now some 43 % are recorded outside, viz., in Area IV, a fact, if correct, that also confirms decrease in the “shallow water” fish, the plaice.

The figures, percentages etc. should, however, be considered with every reservation on account of shortage of records. It must, however, be noted that the calculations seem to confirm the general impression.

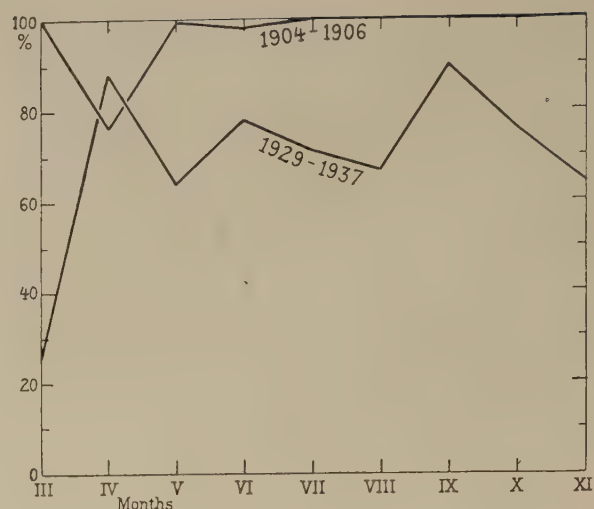


Fig. 17. Relative Number of Steam Trawlers in the Faxa Bay Proper (Areas I—III) in Percentages of all Trawlers observed in the whole Bay (Areas I—IV).

Fig. 17.

Table 40. The Different Nations' Relative Share in the Use of Different Fishing Implements in the Faxa Bay Proper in the Years 1927—1937.

Nationalities	Trawl	Long-line Steamers	Long-line Motorboats	Handline	Seine-net	Drift-net	Whaling.
Icelandic.....	28.3	70.5	94.4	50.8	100.0	100.0	—
Norwegian.....	0.1	28.3	2.8	—	—	—	100.0
Swedish.....	—	—	2.8	—	—	—	—
British.....	62.3	1.2	—	0.7	—	—	—
German.....	6.2	—	—	—	—	—	—
French.....	0.8	—	—	—	—	—	—
Dutch.....	0.1	—	—	—	—	—	—
Belgian.....	0.1	—	—	—	—	—	—
Spanish.....	0.3	—	—	—	—	—	—
Faroe Islands.....	1.8	—	—	48.5	—	—	—
Total	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Number	857	174	36	160	86	24	31

Table 41. The Relative Number of the Different Fishing Tackles used in the Faxa Bay Proper by the Different Nations in the Period 1927—1937.

Nationalities	Trawl	Long-line Steamers	Long-line Motorboats	Handline	Seine-net	Drift-net	Whaling.	Total
Icelandic.....	41.9	20.3	5.6	14.0	14.2	4.0	—	100.0 %
Norwegian.....	1.2	59.8	1.2	—	—	—	37.8	100.0 %
Swedish.....	—	—	100.0	—	—	—	—	100.0 %
British.....	99.4	0.4	—	0.2	—	—	—	100.0 %
German.....	100.0	—	—	—	—	—	—	100.0 %
French.....	100.0	—	—	—	—	—	—	100.0 %
Dutch.....	100.0	—	—	—	—	—	—	100.0 %
Belgian.....	100.0	—	—	—	—	—	—	100.0 %
Spanish.....	100.0	—	—	—	—	—	—	100.0 %
Faroe Islands.....	13.7	—	—	86.3	—	—	—	100.0 %
Total.....	857	174	36	160	86	24	31	

V. A Survey of Nations fishing in the Faxa Bay Proper.

Tables 40 and 41 give information as to the relative importance of the bay to the fishing-fleets of the different nationalities and to the different gears employed. The tables include vessels the nationality of which is known. As regards the trawlers (Table 40) 62.3 % of the number recorded in the Bay are British, 28.3 % Icelandic and 6.2 % German. Thus the trawlers of these 3 nationalities make up 97 % of all trawlers in the bay, the remaining 3 % being from 6 other nations. The long-line fishing is mainly carried out

each nation. German, French, Dutch, Belgian and Spanish fishermen use the trawl exclusively and Great Britain almost exclusively (99.4 %), while Icelandic vessels are recorded with 41.9 % using trawl, 14.2 % seine-nets, 25.9 % long-line.

Excluding whalers, the Norwegians employ long-line to the extent of 96 %. Faroese vessels are recorded with 86.3 % for handline, and 13.7 % for trawl.

In Tables 42 and 43 similar records have been calculated for the period 1904—1906. Also then

Table 42. The Different Nations' Relative Share in the Use of Different Fishing Implements in the Faxa Bay Proper in the Years 1904—1906.

Nationalities	Trawlers	Long-line	Handline
Icelandic.....	1.8	2.7	97.7
Danish ¹	1.2	97.3	—
British.....	95.8	—	—
French.....	—	—	2.3
Belgian.....	1.2	—	—
Total	100.0 %	100.0 %	100.0 %
Number	165	37	44

¹ Carrying Danish flag. Probably the trawlers and the long-liners are Icelandic, but it is also possible that some of the longliners are Faroese cutters fishing with handline.

by the Icelandic steamers (70.5 %), which with the Norwegian vessels (28.3 %) comprise 98.8 % of all line-steamers recorded in the Bay. The great majority of long-line motor-boats is Icelandic (94.4 %) and also hand-line vessels from Iceland predominate with 59.8 %, seconded by 48.5 % from the Faroe Islands. As to the Danish-seine and the drift-net all vessels with those gears recorded in the bay seem to be Icelandic, while all whalers were Norwegian.

While Table 40 records the distribution of each fishing gear among the nations fishing in the bay, Table 41 records the distribution of the gears within

Table 43. The Relative Number of the Different Fishing Tackles used in the Faxa Bay Proper by the Different Nations in the Period 1904—1906.

Nationalities	Trawlers	Long-line	Handline	Total
Icelandic.....	6.4	2.1	91.5	100.0 %
Danish ¹	5.3	94.7	—	100.0 %
British.....	100.0	—	—	100.0 %
French.....	—	—	100.0	100.0 %
Belgian.....	100.0	—	—	100.0 %
Number	165	38	43	.

British trawlers predominated by 95.8 %, while Denmark is recorded by 95 % of long-line vessels, while all hand-line fishing was carried out by the Icelanders. Icelandic vessels were flying the Danish flag up to 1918; presumably the many "Danish" long-line vessels should be Icelandic, as very few Danish vessels fished in Icelandic waters in the period under review. Finally Table 43 gives an idea of the different nationalities fishing in the bay. The trawling was then just as now the only method of fishing employed by British and Belgian fishermen, while French and Icelandic vessels have changed from line-fisheries to trawling.

VI. Appendix

May 1946

Since the above paper was written in 1937, observations of 5 years have been added, viz., from 1938, 1939, 1940, 1941 and 1945. Unfortunately only one of these years, 1938, may be termed as normal, 1940 and 1941 being war years, 1939 and 1945 making a crossing to and from the war conditions. It is not easy therefore to apply the material from these years for comparison with the records given in the above paper. In spite of that it may be useful to consider the additional information now available.

Observations were carried out all around the coast and at every time of year as far as possible.

The number of days of observations were as follows:

Year	All Waters (incl. F. B.)	Faxa Bay only
1938	241	78
1939	297	147
1940	297	138
1941	170	62
1945	125	47
Total	1,130	472

In Table 44 the total number of vessels observed every year, partly all around the country, partly

in the Faxa Bay proper, are recorded, according to the three main types of fishing tackle used.

Table 44.

Year	Trawl		Dan.-Seine		Long-line	
	Total	F. Bay	Total	F. Bay	Total	F. Bay
1938	1,112	163	82	35	79	28
1939	2,621	717	247	103	1,177	292
1940	1,536	309	375	74	1,712	328
1941	528	120	138	45	569	28
1945	535 ¹	201 ²	174	32	75	3

¹ 254 motor-trawlers included.

² 180 motor-trawlers included.

We will now consider the number of different types of fishing vessels seen in Faxa Bay (proper) as an average for ten-day observations, as shown by the following figures:

Years	Trawlers	Dan.-Seine	Long-line
1904—1906	80	0	5
1929—1937	88	4	21
1938	33	7	6
1939	49	7	20
1940—1941	20	6	15
1945	42	7	1

If we regard the trawling in the bay it will be seen that it decreased greatly in the years just before the war, but the further decline during the war years 1940—1941, originates, as will be shown later from the withdrawal of the foreign trawlers as well from Faxa Bay as from other Icelandic waters. The rather stable increase in 1945 is a result of a development passed during the war, consisting in that more and more Icelandic motorboats have been equipped with otter-trawl at the expense of the long-line. The fishing with Danish seine seems to have been fairly invariable after 1930, but it must be noted, that the rather low number of vessels observed is due to the fact, that fishing with this tackle is only allowed for a part of the year on the territory, and the greater part of the extra-territorial section in Faxa Bay is badly suited for seine-netting. The long-line fishing in the Bay proper seems to have changed rather notably from year to year. The low number in 1938 may partly be due to lack of observation in January and February this year, but these two months make a good part of the principal cod season, the best time for the long-line in Faxa Bay. On the other hand we know, that the use of long-line is steadily decreasing succeeded by the trawl, except when fishing for the mature cod during winter and spring.

The low number of trawlers observed in the Bay during the war years, is not only due to the fact that the area was almost exclusively visited by Icelandic trawlers — all foreign trawlers withdrawn with the exception of some few English —. The main reason is that the bay has given rather poor yields during this period and that in war years fishermen rather prefer quantity catches, which have to be fetched from deep waters, than quality catches, which are the speciality of the Faxa Bay area. Otherwise the bay would have been of still greater importance than in peace time, owing to the following reason. Reykjavík and Hafnarfjörður, which are situated at the Faxa Bay, are by far the most important trawler ports in Iceland. Due to the great risk and the high rates of insurance on the voyages to Great Britain with the catch, the trawlers left the fishing tackle and the major part of the crew in the home harbour before leaving for England. The same was the case with all other larger vessels which brought their fish on own keel to British ports. Most of them had to leave from a port at Faxa Bay and call for the same harbour again when back before commencing to fish. Taking this into consideration Faxa Bay would have been especially favoured, had it not been for the relatively poor yields.

It remains, finally, to regard the percentage number of trawlers during the latest years in Faxa Bay, with regard to nationality, as compared with corresponding figures from earlier years. A survey on this subject can be given by the following figures (Percentages).

	Icelandic	British	German	Others	Total
1904—1906	3.0	95.8	—	1.2	100.0
1929—1937	28.3	62.3	6.2	3.2	100.0
1938	11.1	88.0	0.9	—	100.0
1939	32.4	64.1	2.3	1.2	100.0
1940—1941	85.4	9.3	—	5.3 ¹	100.0
1945	73.4	26.6 ²	—	—	100.0

¹ French and Faroese.

² Approximate.

The very low Icelandic percentage for 1938 is partly due to the quota system in international trade, which drastically depressed the activities of Icelandic fishing for British and German markets. — It must finally be pointed out that no German trawler was observed after the end of July 1939 and no British after the end of August. British trawlers appeared again in 1940 and were noted every month that year and until the end of October 1941.

**TOTAL YIELD (TONS) OF HALIBUT, PLAICE, LEMON SOLE, HADDOCK
AND COD IN ICELANDIC WATERS DURING THE YEARS 1906—1938**
(from Bull. Statistiques. Cons. Internat. — corrected.)

BY

ÁRNI FRIDRIKSSON and Å. VEDEL TÅNING

The five most important species of demersal food-fishes in Icelandic waters are the halibut, plaice, lemon sole and haddock due to their highly appreciated value and relative density, and the cod on account of its enormous number in this area. The main biological features of these species have already been given in outline in the papers Nos. 8—12. Yet it remains to account separately for the quantities taken annually at Iceland of each of these species. This is done by means of the following five tables (45—49) which are extracted from the corrected international statistics. Besides the total amount caught from year to year the tables give evidence of the relative yields to each country concerned. It is not necessary to go into details for explaining the tables, which are merely intended to emphasize the paramount importance of the Icelandic area for the above named species. Some few explanatory remarks may, however, be added.

For the yield of halibut the area is one of the three most important areas in the North Atlantic and the adjacent arctic waters. The annual yield has ranged from about 2,500—7,900 tons, war years excluded, and the major part of the catches has been taken by British fishermen. A remarkable decline in the yields can be noted as is pointed out in Paper 8.

In the case of the plaice the annual output has varied from about 4,600 to 10,400 tons and we find the same trend to decreasing catches as for the halibut. English steam trawlers have taken by far the largest part of the catches, seconded in late years by the Icelanders (see Paper 9).

As regards lemon sole the annual output has tended to increase during the later years. It has been very varying, ranging from less than 300 tons in the early years of the century up to more than 3,000 tons in recent years (see Paper 10). English steam trawlers have taken the major toll of this species too, but it must be kept in mind that the Icelandic fisheries statistics did not record this species separately until after 1931. Up to that time lemon sole as well as witch and megrim were recorded under the same heading as plaice.

The haddock stock has given much higher quantities annually than the three fishes named above, varying from 24.5 to almost 53 thousand tons. The English share in the catches has been far in excess of that of other countries, seconded by Icelandic and German yields. The table shows clear evidence of decline in the total landings during recent years (Paper 11).

The annual yield of cod in Icelandic waters exceeds several times the yield of any other demersal species taken here. The total output has ranged from well over 100 to nearly 520 thousand tons a year. Almost the half of this catch has been taken by Icelandic fishermen, but the cod fisheries at Iceland are of great value for many other nations, especially England, Faroe Isles, France, Norway and Germany. No decline in the annual yields can be noted, on the contrary the density seems never to have been so high as in the early thirties. This may be due to the warming up of the arctic waters during recent years and the consequent expansion of the stock.

Table 45. Total Yield of Halibut Fishery in Tons.

Year	Belg.	Denm.	Engl.	Faroe	Germ.	Holl.	Icel.	Norw.	Scotl.	Swd.	Total
1906	4	—	4,983	—	84	9	299	—	46	—	5,425
1907	1	—	7,219	—	185	10	375	—	100	—	7,890
1908	6	—	6,939	—	268	14	253	—	75	—	7,555
1909	20	—	5,445	—	307	20	173	—	41	—	6,006
1910	11	—	4,632	—	419	26	132	—	928	—	6,148
1911	5	—	4,831	—	449	13	233	—	251	—	5,782
1912	4	—	4,090	—	323	13	261	—	266	—	4,957
1913	—	—	3,500	—	255	10	252	—	235	—	4,252
1914	—	—	2,649	—	113	4	87	—	198	—	3,051
1915	—	—	1,102	—	—	28	68	—	118	—	1,316
1916	—	—	—	—	—	27	64	—	58	—	149
1917	—	—	—	—	—	—	57	—	13	—	70
1918	—	—	—	—	—	—	443	—	—	—	443
1919	—	—	722	—	54	—	473	—	42	—	1,291
1920	—	—	1,674	—	225	4	731	—	46	—	2,680
1921	—	—	2,201	—	196	14	373	—	58	—	2,842
1922	—	—	4,211	—	296	3	398	—	322	—	5,230
1923	—	—	5,782	—	130	2	398	—	697	—	6,611
1924	—	—	5,270	—	202	3	274	—	577	—	6,052
1925	—	—	5,441	—	330	8	321	—	302	—	6,081
1926	—	—	4,091	—	376	3	280	—	250	—	5,000
1927	—	—	4,443	—	373	3	472	—	403	—	5,694
1928	5	13	2,790	—	373	4	340	—	229	—	3,754
1929	15	1	2,010	—	352	3	330	—	134	—	2,845
1930	7	3	1,629	1	313	3	413	—	165	4	2,538
1931	4	6	1,879	2	325	3	543	1	281	—	3,044
1932	11	22	2,098	4	321	1	322	15	163	1	2,958
1933	8	20	1,965	2	309	—	283	339	139	—	3,065
1934	9	16	2,087	2	318	—	383	66	177	—	3,058
1935	12	18	1,919	3	293	—	382	82	109	—	2,818
1936	15	19	1,661	1	391	—	267	38	215	—	2,607
1937	26	14	1,827	5	434	—	256	—	306	—	2,868
1938	26	24	1,284	5	544	+	411	69	366	—	2,729

Table 46. Total Yield of Plaice Fishery in Tons.

Year	Belg.	Denm.	Engl.	Faroe	Germ.	Holl.	Icel. ¹	Norw.	Scotl.	Swd.	Total
1906	36	—	9,468	—	181	44	?	—	107	—	9,836
1907	19	—	8,755	—	188	8	?	—	105	—	9,075
1908	30	—	6,326	—	296	19	?	—	76	—	6,747
1909	33	—	5,093	—	305	53	?	—	38	—	5,522
1910	38	—	4,610	—	263	23	?	—	?	—	4,934
1911	20	—	5,139	—	290	18	?	—	85	—	5,552
1912	11	—	6,160	—	439	14	?	—	109	—	6,733
1913	—	—	4,889	—	190	7	387	—	92	—	5,565
1914	—	—	3,852	—	74	8	175	—	96	—	4,205
1915	—	—	2,315	—	—	13	109	—	69	—	2,506
1916	—	—	—	—	—	21	178	—	104	—	303
1917	—	—	—	—	—	—	5	—	36	—	41
1918	—	—	—	—	—	—	202	—	—	—	202
1919	—	—	6,094	—	65	—	473	—	171	—	6,803
1920	—	—	9,104	—	283	2	912	—	67	—	10,368
1921	—	—	5,225	—	210	26	527	—	26	—	6,014
1922	—	—	4,421	—	366	14	864	—	207	—	5,872
1923	—	—	5,134	—	157	3	665	—	307	—	6,266
1924	—	—	4,582	—	280	7	453	—	375	—	5,697
1925	—	—	5,048	—	507	16	381	—	349	—	6,301
1926	—	—	5,207	—	397	10	670	—	242	—	6,526
1927	—	320	6,335	—	382	3	688	—	153	—	7,881
1928	2	201	5,222	—	347	2	601	—	18	42	6,435
1929	11	101	5,240	—	479	8	687	—	37	—	6,563
1930	2	338	6,219	19	479	7	1,139	—	75	—	8,278
1931	3	440	5,816	109	417	8	1,650	13	41	—	8,497
1932	5	424	4,668	68	252	1	932	—	45	3	6,398
1933	4	380	3,557	41	162	—	413	—	25	60	4,642
1934	1	341	3,587	23	104	1	597	—	16	—	4,670
1935	11	343	4,094	28	45	—	796	—	20	—	5,337
1936	9	376	3,487	20	60	—	1,172	—	25	—	5,149
1937	8	273	3,612	30	53	—	1,565	—	26	—	5,567
1938	11	248	2,710	39	46	—	760	—	19	—	3,833

¹ See introductory notes to this paper.

Table 47. Total Yield of Lemon Sole Fishery in Tons.

Year	Belg.	Denm.	Engl.	Faroe	Germ.	Holl.	Icel. ¹	Norw.	Scotl.	Swd.	Total
1906	7	—	202	—	—	2	—	—	10	—	221
1907	7	—	261	—	—	4	—	—	17	—	289
1908	13	—	263	—	—	12	—	—	59	—	347
1909	11	—	276	—	—	13	—	—	19	—	319
1910	10	—	283	—	7	8	—	—	27	—	335
1911	4	—	401	—	13	6	—	—	36	—	460
1912	2	—	413	—	31	10	—	—	41	—	497
1913	—	—	354	—	25	8	—	—	35	—	422
1914	—	—	275	—	14	4	—	—	55	—	348
1915	—	—	138	—	—	6	—	—	8	—	152
1916	—	—	—	—	—	18	—	—	14	—	32
1917	—	—	—	—	—	—	—	—	10	—	10
1918	—	—	—	—	—	—	—	—	—	—	—
1919	—	—	206	—	2	—	—	—	11	—	219
1920	—	—	317	—	42	1	—	—	7	—	367
1921	—	—	306	—	19	76	—	—	6	—	407
1922	—	—	350	—	27	4	—	—	34	—	415
1923	—	—	564	—	18	6	—	—	49	—	637
1924	—	—	539	—	62	9	—	—	87	—	697
1925	—	—	462	—	77	13	—	—	91	—	643
1926	—	—	706	—	112	5	—	—	77	—	900
1927	—	100	1,204	—	180	4	—	—	102	—	1,590
1928	5	77	1,471	—	329	6	—	—	45	—	1,933
1929	17	16	1,437	—	352	6	—	—	23	—	1,851
1930	7	32	1,345	—	255	7	—	—	22	4	1,672
1931	5	52	1,629	5	217	6	—	—	16	—	1,930
1932	8	34	2,066	2	202	6	64	—	26	8	2,416
1933	6	157	1,701	3	244	—	59	—	31	—	2,201
1934	6	129	1,864	2	255	—	52	—	60	—	2,368
1935	16	78	1,989	1	187	—	35	—	60	—	2,366
1936	14	38	2,313	2	259	—	27	—	66	—	2,719
1937	30	27	2,639	9	188	—	31	—	79	—	3,003
1938	25	50	1,848	19	175	1	846	—	70	—	3,034

¹ See introductory notes to this paper.

Table 48. Total Yield of Haddock Fishery in Tons.

Year	Belg.	Denn.	Engl.	Faroe	Fran.	Germ.	Holl.	Icel.	Norw.	Scotl.	Swd.	Total
1906	365	—	21,052	—	—	6,135	477	4,509	—	3,150	—	35,688
1907	289	47	17,949	—	—	5,219	235	3,976	—	3,057	—	30,772
1908	308	—	19,107	—	—	4,951	404	4,347	—	2,070	—	31,187
1909	335	—	16,769	—	—	6,281	545	2,990	—	1,615	—	28,535
1910	201	—	18,311	—	—	5,745	495	3,272	—	2,279	—	30,303
1911	93	—	19,026	—	—	5,864	288	4,093	—	2,487	—	31,851
1912	46	—	15,783	—	—	5,872	283	3,551	—	3,127	—	28,662
1913	—	—	15,313	—	—	5,157	256	3,140	—	3,109	—	26,975
1914	—	—	11,155	—	—	3,252	103	3,594	—	2,583	—	20,687
1915	—	—	12,341	—	—	—	476	6,760	—	1,194	—	20,771
1916	—	—	—	—	—	—	796	8,670	—	2,168	—	11,634
1917	—	—	—	—	—	—	—	9,000	—	1,149	—	10,149
1918	—	—	—	—	—	—	—	9,839	—	—	—	9,839
1919	—	—	19,029	—	—	1,002	—	12,969	—	2,022	—	35,022
1920	—	—	27,921	—	—	11,507	78	11,400	—	2,067	—	52,973
1921	—	—	17,998	—	—	7,156	840	11,019	—	398	—	37,411
1922	—	—	19,151	—	—	9,174	148	13,235	—	3,921	—	45,629
1923	—	—	16,071	—	—	4,737	184	11,942	—	5,321	—	38,255
1924	—	—	16,776	—	—	6,481	267	9,177	—	5,502	—	38,203
1925	—	—	16,931	—	9	5,684	272	8,000	—	4,524	—	35,420
1926	—	—	19,367	—	9	7,613	213	6,260	—	3,478	—	36,940
1927	—	10	30,171	—	—	9,853	226	9,834	—	4,565	—	54,659
1928	234	80	31,125	—	—	14,113	229	11,088	—	310	4	57,183
1929	426	42	27,469	1	45	12,338	257	13,055	—	379	23	54,035
1930	304	100	25,104	75	—	12,156	365	10,863	9	416	—	49,392
1931	119	210	22,872	45	17	9,224	148	7,118	51	389	—	40,193
1932	140	296	18,674	96	264	7,017	62	4,933	—	425	30	31,937
1933	225	341	14,020	29	242	5,954	—	4,683	—	195	10	25,699
1934	206	545	14,814	51	174	4,339	6	5,937	—	227	—	26,299
1935	342	569	15,635	35	99	3,500	—	6,313	—	245	—	26,738
1936	366	840	14,523	118	49	4,062	—	4,205	—	324	—	24,487
1937	372	695	14,558	134	71	4,460	—	4,053	—	337	—	24,680
1938	442	644	14,817	115	75	3,972	6	3,570	—	268	—	23,909

Table 49. Total Yield of Cod Fishery in Tons.

Year	Belg.	Denm.	Engl.	Faroe	France	Germ.	Holl.	Icel.	Norw.	Scotl.	Swd.	Total
1906	484	—	37,779	2,486	—	6,695	1,154	48,302	3,000	6,843	—	106,743
1907	442	24	38,884	3,269	—	8,773	459	53,845	3,200	7,811	—	116,707
1908	707	—	43,050	3,245	—	9,026	798	58,259	2,443	7,435	—	124,963
1909	621	—	32,293	4,621	—	12,686	1,349	56,670	1,388	5,873	—	115,501
1910	469	—	37,969	8,769	—	13,049	1,010	71,007	938	5,968	—	139,178
1911	253	—	44,316	9,647	—	13,455	747	75,114	576	14,556	—	158,664
1912	111	—	43,657	10,008	—	15,389	736	75,499	469	15,113	—	160,982
1913	—	—	54,119	11,247	—	16,411	762	79,870	1,362	17,958	—	181,729
1914	—	—	65,129	8,857	13,056	14,561	761	53,473	324	19,937	—	176,098
1915	—	—	34,028	12,126	2,661	—	1,233	66,030	386	2,660	—	119,124
1916	—	—	—	15,868	1,350	—	1,809	68,848	636	2,097	—	90,608
1917	—	—	—	8,711	906	—	7	61,413	—	1,485	—	72,522
1918	—	—	—	16,723	937	—	—	62,019	—	—	—	79,679
1919	—	—	27,028	18,441	3,994	1,160	—	76,766	853	2,673	—	130,915
1920	—	—	55,970	16,634	9,053	18,636	464	82,776	—	8,022	—	191,555
1921	—	—	37,019	29,195	2,685	16,515	1,357	90,632	—	1,093	—	178,496
1922	—	—	42,132	40,320	5,837	17,675	582	103,436	280	12,104	—	222,366
1923	—	—	42,444	35,868	2,862	12,391	801	106,391	287	22,402	—	223,446
1924	—	—	62,600	31,481	2,841	26,340	1,315	146,237	468	33,293	—	304,575
1925	—	—	72,012	29,185	3,487	24,984	1,593	159,030	445	34,984	—	325,720
1926	—	—	67,789	38,608	3,967	30,074	1,308	126,890	519	33,015	—	302,170
1927	—	25	80,431	37,651	2,505	32,315	918	164,783	391	24,252	—	343,271
1928	677	17	84,222	49,563	3,567	48,494	841	177,328	322	1,107	—	366,138
1929	2,106	22	81,867	54,223	2,813	53,071	746	201,074	1,085	2,202	65	399,274
1930	1,581	15	99,267	53,002	5,230	67,091	1,444	261,278	6,691	2,836	—	498,435
1931	1,082	36	117,415	53,670	8,739	66,920	1,339	224,504	7,339	2,358	—	483,402
1932	1,035	173	137,364	48,387	17,623	63,756	605	208,081	3,476	4,784	4	485,288
1933	1,204	67	131,366	46,148	15,271	57,250	—	247,329	16,162	3,478	—	518,275
1934	626	77	121,331	28,028	16,413	32,373	45	223,729	14,898	1,049	—	438,569
1935	1,283	130	127,870	28,776	6,218	37,888	—	182,926	15,284	1,516	—	401,891
1936	1,511	49	117,199	13,866	5,156	33,266	—	102,354	8,310	1,874	1	283,586
1937	1,395	47	120,260	19,706	11,727	30,587	—	111,285	1,180	1,629	—	297,816
1938	1,860	25	106,797	22,405	6,070	35,329	60	114,359	5,180	1,625	—	293,710

REMARKS ON THE OUTPUT AND DENSITY OF FOUR IMPORTANT FOOD-FISHES IN ICELANDIC WATERS

BY

MICHAEL GRAHAM

This study is of the yield, that is, the total landing by all fishermen of all nations from Region Va, as given in the *Bulletins Statistiques*, and of the density, as shown by the Landing per Day's Absence of 1st Class British Steam Trawlers landing their own catch in the British Isles; also, figures on the rate of fishing showing changes in intensity of fishing by British trawlers are available. These are necessarily incomplete, since all countries have not statistics of expenditure of fishing power, and the British statistics take no account of changes in fishing power of the individual vessel.

In plaice it is first to be noted that the increase of yield above normal after the war by no means equalled the decrease of yield below normal during the war. This point will also be seen in the graphs for other species. Its only importance is as a reminder that drastic measures of conservation do not necessarily pay. In this case virtually the whole of the Icelandic region was largely protected during the war, and then recklessly fished, but the subsequent gain in fish supply was less than the loss (Fig. 19).

Turning now to the lower graph, showing density of stock, it seems that there was in general a slow decline in stock from 1922 to 1933, but within this period there was equilibrium or a state very near equilibrium in the four years 1924 to 1927 inclusive. During this period the yield was somewhat above 6,000 tons. Since then the yield has fallen to about 5,000 tons, and the stock has declined to what looks like a new and low position of equilibrium. It might be argued that, because there has not been any certainly shown equilibrium at a higher level of density than the present, there is no reason to believe that any better yield can be maintained than the present 5,000 tons, which is lower than has formerly been experienced. This, however, is not my belief. The figures for density

showed the condition of 1924 to 1927 to be so near equilibrium, with a yield of above 6,000 tons, that I have little doubt that a yield of about 6,000 tons, that is 20 % above that of recent years, could be maintained.

What then, happening in about 1928 to 1931, caused the change to the present inferior position? The data of Fig. 18 leave little doubt that a major part, if not all, of the cause lies in the increase of fishing by steam trawlers. Between 1925 and 1931, covering the period when the adverse change took place, the number of hours fishing by British trawlers during the year increased by the very great amount of 81 %, and this high level has been maintained and lately exceeded. (Allowing for the Vigneron Dahl trawl the increase is about 100 %).

At the same time it is possible that seine-netting by Icelanders in inshore waters has played a part. I have not been able to make out clearly the history of this development. It is to be noted on pp. 42 and 74 (Papers 9 and 16) that there was a remarkable increase in the Icelanders' catch of plaice in 1930 and 1931.

For the haddock, Figure 20 repeats in a remarkable manner the features that have been expounded for the plaice. This repetition strongly supports the view that we are dealing with the result of human operations, not natural phenomena. The period of near-equilibrium is found at the same time, as nearly as can be determined, and gave a yield of over 36,000 tons. Just as there was an adverse decline of the stock of plaice from 1930 to 1933, so a similar decline is shown in the same

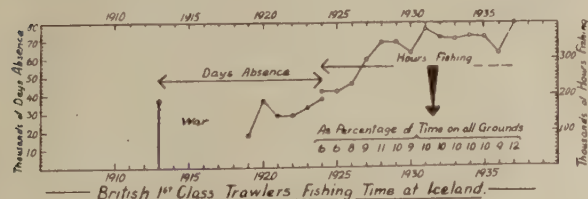


Fig. 18.

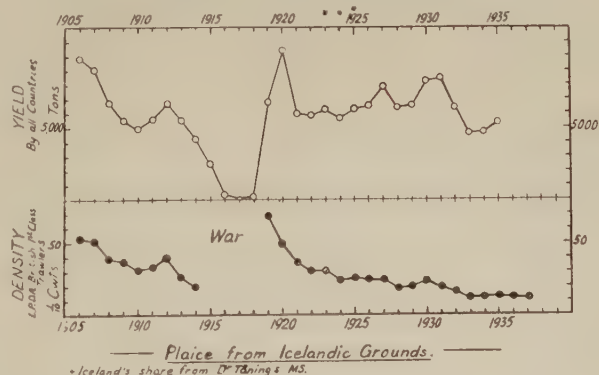


Fig. 19.

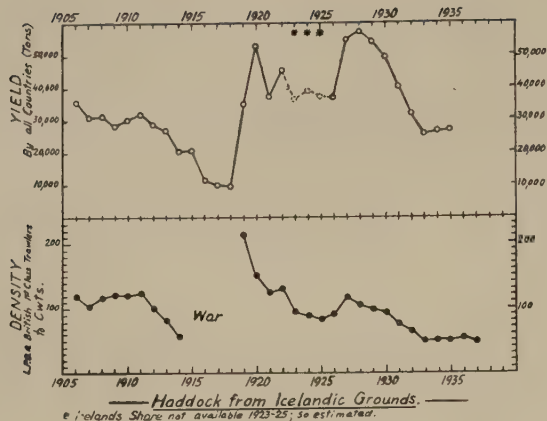


Fig. 20.

years for the haddock, only it begins a little earlier, perhaps in 1927. The yield at the present low equilibrium is about 27,000 tons. In 1923 to 1926 it was about one third more.

In halibut also the present condition seems to be one of unproductively low equilibrium. This, however, was reached as early as 1929. It would be surprising if this is due to increase of trawling alone, for this increase was only just beginning when the step downwards in the stock took place. In the earlier equilibrium, if it was equilibrium, the yield was more than double that of recent years. In this series of statistics the lag in the benefit of war-time protection is particularly interesting. The effect was apparently at its maximum as late as 1923. Could it be due to relative immunity of halibut from fishing for several years between being trawlable "chickens" and trawlable adults? Or is it the result of a successful generation owing to war-time reduction in fishing of spawners?

Statistics of cod may be put in as a contrast. In this case it seems that increased fishing has been beneficial to the yield. But such is the calling of the fishermen that the consequent glut of markets has put many of them high and dry on land.

It seems that the trouble with Icelandic fisheries

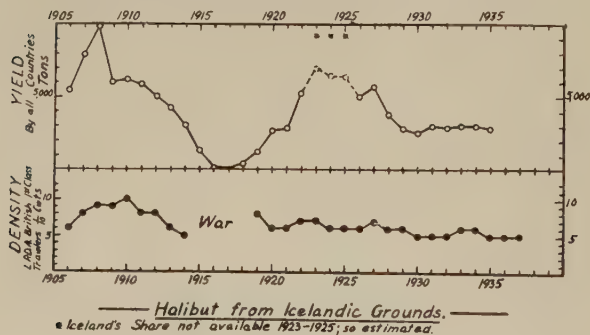


Fig. 21.

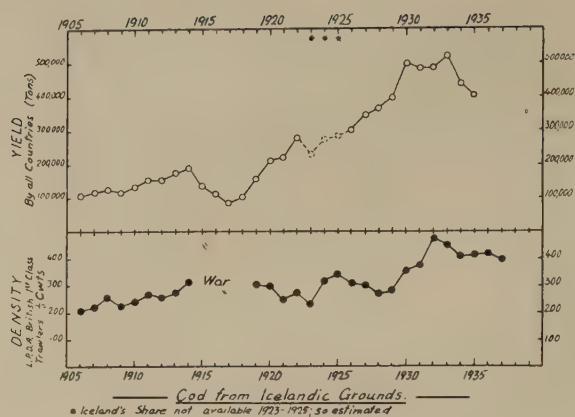


Fig. 22.

for halibut, haddock and plaice is a decline to a relatively unproductive level of density of stock, owing to too much fishing. The biggest feature is too much trawling, but it would be interesting to know whether the decline in the stock has not also coincided with the development of seine-netting on an increased scale by Icelanders.

That so widespread an evil as general overfishing of the Icelandic region could be cured by diversion of trawlers and seine-netters from one part of the region, Faxa Bay, seems unlikely, and there is something to be said against recommending a mere palliative, lest it be claimed by the vendors of our product as a certain cure.

If, however, we are prepared to recommend any palliative, I think we should first enquire whether the protection of inshore waters from the seine-net would not be more effective than diversion of fishing from Faxa Bay.

If, finally, we are prepared to judge the Faxa Bay proposal entirely on its own scientific merits, without any consideration of the magnitude of the benefit compared with the magnitude of the evil, then there seems little doubt from the papers that have been submitted that the proposal is good. Only I have wondered if almost the same result, as regards flatfish, could not be obtained by closing a smaller area, such as the Akranes grounds. This would leave the sprag fishing free, I gather. I have no means of knowing whether such a more modest proposal would be less objectionable to the opposition in the industry, but I have wondered whether it would be worth while approaching the appropriate associations to ask them whether they would be prepared to make a voluntary agreement to keep outside the line Hjortsey to Skagi (see Fig. 13, p. 61), provided the seine-netters spared the same area. International co-operation could then be confined to arranging for reports from sources trusted by everyone as to whether the agreement was being kept by all parties.

SOME THEORETICAL CONSIDERATIONS IN RELATION TO THE
PROPOSED CLOSURE OF FAXA BAY

BY

ÁRNI FRIDRIKSSON

I. Introduction.

It is a well-known fact that many of the principal species of food-fishes in European waters reach maturity at higher age in the north where the water is cold, than in southern, warmer waters. Thus, the cod at the coasts of Iceland does not reach maturity before 8—10 years old if growing up off the north and east coast, but already when 5—6 years old in the warmer water at the south and south-west coast. In more southern waters the cod may mature at a still lower age. Likewise, haddock mature when 3 years old in the northern North Sea (RAITT 1936), but in the Faxa Bay not before the end of the 5th year. Generally the same results may be recorded for many other species, the plaice for instance. As a rule the growth of the fishes is slower in the cold water areas than in the warm ones, but exceptions are known, as for instance the haddock, which grows faster at Iceland than in most other places, although not until after its first year.

The methods, by means of which we are going to protect the young stages of our valuable species of fish have until now consisted of:

- a) Mesh-regulations for bottom-gears, and
- b) Size-regulations for species.

It has probably long been realized that prospects of improvement by such measures are better for quicker growing fish than for slow ones, but the point is of sufficient importance to merit a somewhat formal information, which is here attempted.

Assuming that we can protect a certain species of fish with 100 % efficiency up to the size-limit x cm. for instance in the North Sea, and that this species will reach maturity at a size of y cm. ($y > x$), obviously the dangerous period as regards the toll on the immature stock through fishing is the period in which the fish grows from x cm. to y cm. The greater number taken between the x cm. and y cm. the less becomes the number appearing on the spawning grounds later on. And the longer time it takes the fish to grow from x up to y cm.,

the greater the toll must be on this stock; and the fishery may be a factor of so outstanding importance, that it may exceed other factors influencing the stock at this stage of life, so acting as a limiting factor even on the future stock. The time it takes a fish to grow from x to y cm. may be recognized as "the critical period".

To study the importance of the length of the critical period let us consider a widely distributed species, with a long critical period in the north and a short one in the south, corresponding to a faster growth in the southern than in the northern locality. Thus presuming that the minimal market size-limit x be reached at the end of the 2nd year in the south, and at the end of the 3rd year in the north, and that maturity is reached at the end of the 5th year in the south and at the end of the 8th year in the north, the critical periods for the species will be 3 and 5 years south and north respectively. Estimating the number of fish entering, the critical period as equal in both localities, say 1,000, and the annual mortality (fishing plus normal mortality) during the critical period at 50 %, we may follow the two stocks year by year, as sketched in Table 50, (see also Fig. 23). Beginning with the southern stock, the number of individuals at the end of the 2nd year is here 1,000. The annual toll being estimated at 50 % means that 125 individuals — or 12.5 % — will reach maturity by the end of the 5th year.

Table 50.

	Southern Place	Northern Place
End of 1st year	1,000 +	1,000 +
" " 2nd "	1,000	1,000 +
" " 3rd "	500	1,000
" " 4th "	250	500
" " 5th "	125	250
" " 6th "	—	125
" " 7th "	—	62 ¹
" " 8th "	—	31 ¹

¹ Fractions omitted.

Similar considerations on the northern stock mean that 1,000 individuals of a year-class entering the fishery as 3-year-old fish must be recruited from a somewhat larger quantity of fry than the southern stock, as the 1,000 individuals have been subject to natural mortality for one year more. At the end of the first year the stock is, let us say $1,000 + b_1$, at the end of the 2nd year $1,000 + b_2$, and at the end of the 3rd year 1,000 pass the limit x cm. and enter the fishery. The decrease in stocks being estimated at 50 % per annum, means a decrease during the critical period to $31\frac{1}{4}$ fish out of 1,000 that will reach maturity. Equal recruit-

number of fish reaching first maturity in northern waters might be compensated by the number of spawning years, but this does not seem probable. Let us assume that the 125 mature fish in the southern place spawn once only, but the $31\frac{1}{4}$ fish in the northern place will spawn every year as long as a single fish is alive. We then get the total number of spawning fish in the north

$$N = \sum \left[31\frac{1}{4} + \frac{31\frac{1}{4}}{2} + \frac{31\frac{1}{4}}{4} + \dots \right] = 62\frac{1}{2} \text{ against } 125 \text{ in the southern place.}$$

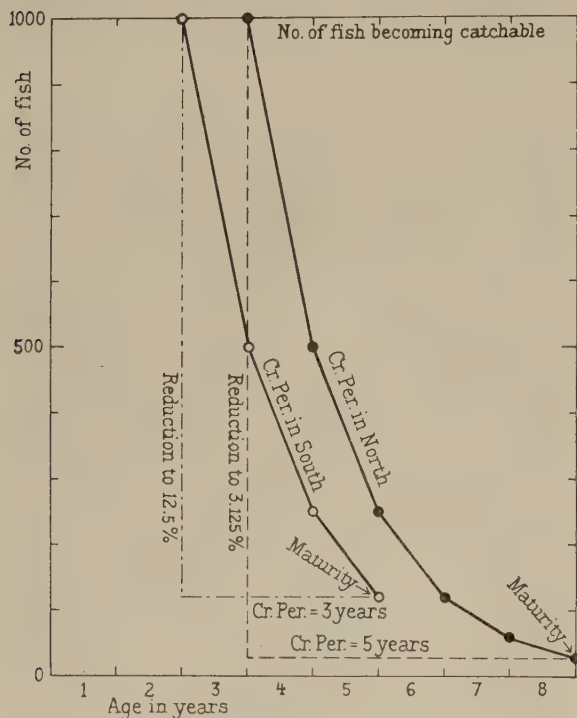


Fig. 23. A Scheme illustrating the Influence of a Critical Period (Cr. Per.) of three years and five years respectively upon the number of Spawning Fish in a Stock.

ment at the length x cm. — in the south 2 years old, in the north 3 years — subject to an annual toll of 50 %, thus means 87.5 % decrease of stock in the south, but 96.8 in the north before maturity is reached.

Assuming that 125 fish are sufficient for maintaining equilibrium in a stock at a given fishing intensity, the protective measures may be said to secure 100 % efficiency in the south while in the north the efficiency is 25 % only, due to the longer critical period.

When speaking of maturity at 5 years of age in the south and 8 years in the north for a hypothetical species, first maturity is implied. It might be suggested that the late maturity and the small

II. The probable Importance of Number of Eggs produced.

The considerations set forth on the preceding page assume that the size of a year-class is more or less dependent upon the number of spawning fish on the spawning ground. Assuming this to be correct, the great reducing significance of a long critical period is evident. It may, therefore, be advisable to discuss the matter from this point of view.

The arguments in favour of the importance of the number of spawning fish, may be represented by the following considerations.

The number of individuals belonging to a year-class must depend upon two major groups of biological, hydrographical and meteorological factors, viz:

a) Nature's influence on the eggs and the larvae, either favouring or disavouring development into a good or bad year-brood, and

b) The number of eggs produced to provide the year-class, which will be proportional to the number of fish spawning.

A large number of fish spawning in a certain year will, by the great number of eggs produced, make a great range of variation in negative and positive direction in genotypical qualities, which are of importance in the development thereafter, in respect of resistance to the influence of bad conditions of environment. If the spawning and the production of individuals is less intensive the variation will be less. Therefore, a large number of eggs will contain a relatively large number of plus-variants, better fit than the mean-type to take up the struggle for life. Secondly, a greater number of spawning fish will most likely spawn over a larger area and over a longer period, thereby giving the individuals produced a better chance of meeting favourable conditions for development than the smaller number could hope to be subjected to.

The decreasing number of the market-category "large", as for instance with the plaice at Iceland, actually must mean a reduced number of fish producing eggs, anyhow of fish that produce the

Table 51. Growth-rate of Haddock in Faxe Bay and in the North Sea.

	Age	Faxe Bay	North Sea	
Minimal size	1	16.5	17.1	
	2	30.5	24.5	Minimal size
Cr. Per. =	3	39.7	29.5	Cr. Per. = 1 year
3 1/2 year	4	47.9	33.5	Maturity
	5	55.1	37.0	
Maturity	6	60.4	41.0	

greatest number of eggs. Such stock of fish, with a long critical period, brought down to a low level, will naturally need a relatively long period for regeneration. Thus the war, as pointed out in Paper 17, was not able to bring the plaice in Icelandic waters up to a level, that could maintain high equilibrium for a longer run of years when fishing was recommenced. Probably this was due to the period of protection, viz. four years being less than the critical period for this species. In respect of halibut the critical period is very long, and much longer than the duration of the great war, accordingly any increase per unit of gear was practically unnoticeable in the fishery. On the other hand, the increase of the haddock stock in the year 1919, to 300 % in comparison with the last intensive fishing year before the war supports the theory, since the period of protection, 4 years, was longer than the critical period for this fish, estimated at 3½ year in Faxe Bay.

Noticing, that the number of eggs produced by a fish during a spawning season depends on the size of the fish, we might suppose, that a fish with a long critical period, spawning at a relatively high age, would produce a greater number of eggs than another fish spawning at a young age. This is perhaps also the case to a certain extent. But dealing with a limited area, as for instance the Icelandic waters, the maturity corresponds to size more than to age, indicating that it will take a fish, growing up in the cold part of the area, longer time to reach maturity than one growing up in the warmer parts, confirmed by the fact that 9 or 10-year first time spawners and older ones, in the cod stock for instance are not noticeably larger than the average of those spawning when 8 years old.

III. Critical Periods of the Haddock.

Summarizing previous assertions as follows: —

1) Length of the critical period largely depends on latitude (Temperature).

2) A long critical period will produce fewer spawners, subject to even recruitment and even mortality.

3) The number of spawning fish may be brought so far down that it may limit the stock. The haddock may be chosen as an example of a fish with differing critical periods. From this point of view its fate in the northern North Sea and in the Faxe Bay may be reviewed.

The records in Table 51 have been derived from RAITT's paper, No. 11, giving the growth-rate for the haddock in Faxe Bay and the North Sea (page 52). He also gives the age of maturity at the end of the 5th year in Faxe Bay and two years earlier in the North Sea, at the end of the 3rd year.

A glance at Table 51 shows that the Faxe Bay haddock will pass the marketable limit (24 cm.) and "enter" the fishery at an age of about 1.5 year. As spawning does not take place until the end of the 5th year, we here have to deal with a critical period of 3.5 years. The North Sea haddock, on the other hand, reach the "marketable" limit as 2-year-old fish, and become mature only one year later, so that its critical period only lasts one year.

In lack of information as to the rate of mortality in the two stocks of haddock it will meet our case to assume the same mortality in both areas during the critical period, say 50 % per annum. On this assumption Table 52 and Fig. 24 illustrate the reduction of the stocks before reaching maturity.

As regards Faxe Bay 1,000 fish of a year-class at the age of 1.5 year are exposed to 6 months'

Table 52.

	Age	Faxe Bay	North Sea	
Entering the Fishery	1.5	1,000		
	2	750	1,000	Entering the Fishery
Cr. Per. =	3	375	500	Cr. Per. = 1 year
3 1/2 year	4	187 ¹		
	5	94 ¹		
Spawning	=	94 ¹	500	

¹ Fractions omitted.

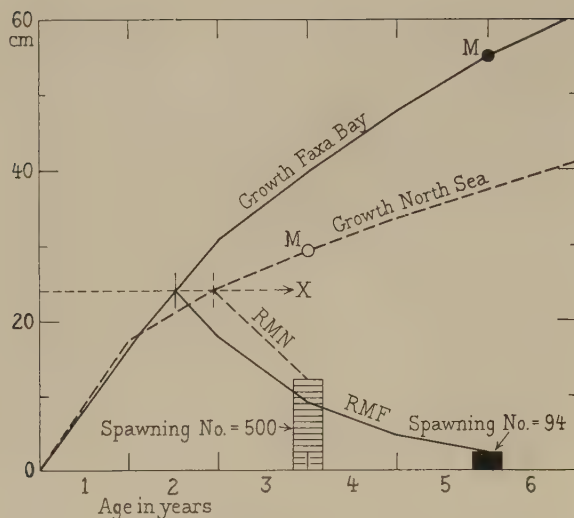


Fig. 24. Diagram illustrating the Run of the Critical Period for the North Sea and Faxe Bay Haddock.
M = Fish arriving at the Stage of Maturity.
X = Minimum size for marketable fish.
RMN = Rate of mortality for North Sea Haddock (Critical period = 1 year).
RMF = Rate of mortality for Faxe Bay Haddock (Critical period = 3.5 years).

fishing, with the result that an annual toll of 50 % leaves 750 individuals by the end of the 2nd year. In the course of the 3rd year the stock will diminish to 375 individuals, during the 4th year it will be reduced to $187\frac{1}{2}$ specimens, and at the end of the 5th year only $93\frac{3}{4}$, or more convenient, 94 fish remain. Thus, out of 1,000 fish that enter the critical period 1.5 year old only 94 reach the spawning age in Faxe Bay.

In the North Sea 500 spawning haddock remain at the age of 3 years out of 1,000 entering the critical period as 2-year-old fish. A mortality of 50 % would reduce the spawners to 9.4 % of "market-recruits" in Faxe Bay, while 50 % spawners would be present in the North Sea, viz., the capacity of production should be 5 times that of Faxe Bay.

If we know the rate of mortality for the haddock in the North Sea during the critical period, we can calculate what the rate of mortality in the Faxe Bay haddock should be in order to give the same number of spawners. This is done by the formula:

$$1 - x = (1 - y)^{\frac{1}{3.5}} = (1 - y)^{\frac{1}{7}}$$

where x is the mortality index (annual mortality divided by 100) for the North Sea and y the corresponding index for the Faxe Bay.

Substituting x by 0.1, 0.2, ... 0.9 corresponding to the mortalities 10, 20, ... 90 % per annum in the North Sea we find the corresponding values for y. The result is shown in Table 53 and in Figure 25.

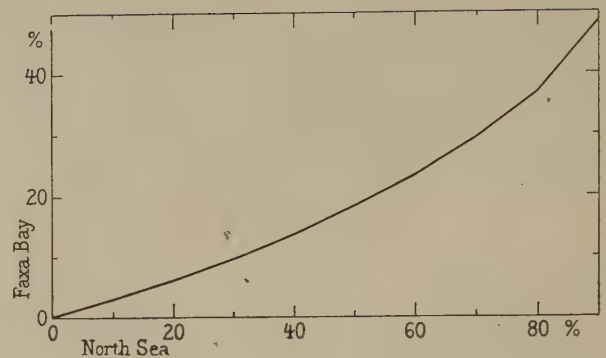


Fig. 25. Corresponding Rates of Mortality for North Sea and Faxe Bay Haddock.

It is assumed that the duration of the critical period is 1 and 3.5 years respectively and that the same percentage will reach maturity.

Table 53. Assumed Rates of Mortalities for Haddock during the Critical Period in the North Sea and the Corresponding Mortalities in Faxe Bay.

Rate of Mortality North Sea Cr. Per. = 1 year	Corresponding Rates for Faxe Bay Cr. Per. = 3.5 years
% per annum	% per annum
10	3.0
20	6.2
30	9.7
40	13.6
50	18.0
60	23.0
70	29.1
80	36.9
90	48.2

IV. Conclusions.

If we acknowledge the significance of the number of eggs produced and consequently the importance of the critical period, we will be able to explain the less resistance in the northern stocks than in the southern ones. The conclusion of that would be that protective measures which are sufficient to maintain a profitable fishing equilibrium in one area do not possibly need to be so in another one with a longer critical period.

To give such extra protection to northern stocks it seems recommendable either to

- 1) Enlarge the mesh of gears.
- 2) Increase the minimum size-limits.
- 3) Experimentally to close suitable nursery grounds for a period exceeding the critical period of the fishes that are to be protected.
- 4) Limit the fishing activities.

APPENDIX

The Effect of Decreased Fishing Activities during the War 1914—18.

As regards the three species, halibut, plaice and haddock, dealt with in Paper 17 it appears that the war protection has shown a profit. Making use of the figures and graphs in Paper 17, the development may be followed during and after the war.

Halibut.

In the years prior to the war, the total amount of halibut caught at Iceland was declining, in 1913 it was about 4,300 tons, and the catch per "day's absence from port" had declined to about 0.5 cwt. in 1914. The stock of the halibut had reached no equilibrium on its way downwards due to the intensity of the fishery, and consequently it may be argued that the total catch hardly would have exceeded 4,300 tons in any year after 1914, if no "protection" had taken place. The loss in 1914—1918 may be estimated at about 16,400 tons. In 1919, English trawlers record 0.8 cwt. per day's absence or 60 % advance as compared with 1914. But the total yield during the three years succeeding the war was not good, neither could any appreciable increase be expected when considering the long "critical period" of the halibut (at least 7 or 8 years). In each of the six years, 1922—1927, the total yield, however, exceeds that of 1913 (4 300 tons) by some 700 to 2,700 tons, probably corresponding to the six year-classes of halibut 1914—1919. However, the protection was by no means effective, very likely because the time of protection was shorter than the critical period of the species. No new generation had full protection during its entire critical period. The loss between 1914—1921, therefore, was greater than the profit in 1922—1927 by some 16,700 tons, if we admit a probable equilibrium of 4,300 tons.

Plaice.

As to the plaice the total yield per annum as well as the catch per day's absence were decreasing in pre-war years. Thus the yield in 1912 was about 6,700 tons and the catch per day's absence about 3.9 cwts. In the year 1913, the corresponding numbers were 5,500 tons and 2.5 cwts., while in the first year of the war, 1914, the average catch decreased to about 2 cwts. Therefore, the normal yield between 1914—1918 could hardly be expected to exceed 5,500 tons per annum without protection. Immediately after the war, in 1919 the highest yields since 1906 could be recorded and the catch per day's absence (7 cwt.) exceeded that of any other year in the century, followed in the succeeding years by a decrease. Assuming that the 1914—1918 yields would have been 5,500 tons annually,

the loss in this period may be estimated at 19 800 tons ($5 \times 5,500$ tons less the actual catch) — although 5,500 presumably may be considered as a maximum. Further, estimating the post-war yield at 5,500 per annum, if no protection had taken place, the years 1919—1930 make up for some 14,000 tons of the estimated loss. Furthermore in 1930 the catch per day's absence is close to that of 1914 (about 2 cwts.). In 1931—33 a decrease is recorded, but in 1933 an equilibrium seems established.

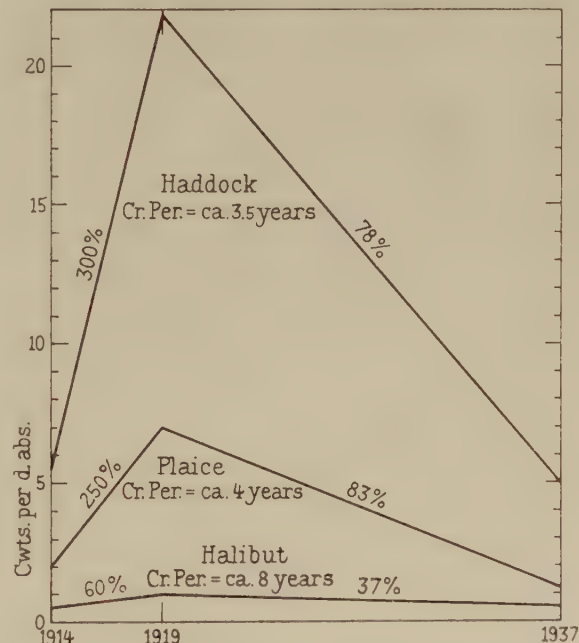


Fig. 26. Increase during the War and Decrease after the War in the catches per Unit of Gear for Haddock, Plaice and Halibut in Icelandic Waters.

Cr. Per. = Critical Period. Cwts per D. Abs. = Cwts. per Days Absence from port.

To my mind, the plaice seems to have yielded more in the years after the war than was lost during the war. In this connexion it might be pointed out that the time of protection almost equalled the length of the critical period of the plaice.

Haddock.

In pre-war years the yield of haddock was decreasing from some 33,000 tons to some 27,000 tons in 1913; the catch per day's absence from 12 to 8 cwts. Considering 27,000 tons a probable equilibrium, the loss during 1914—1918 may be estimated

at about 62,000 tons. Maintaining the equilibrium in post-war years would result in a surplus of 147,000 tons up to 1930 incl., whereas the catch per day's absence throughout this period, although steadily decreasing from 20 cwts. (1919) and 14 cwts. (1920), has been above or equal to that of 1913 (8 cwts.). The period of protection was somewhat longer than the critical period for the had-

dock, which is 3.5 years in an area like the Fæa Bay. The peak of the yield occurs in 1928, since when a steady decrease is recorded until 1933, when apparently an equilibrium has again been established near 27,000 tons. Haddock, thus, seems to have shown a pronounced profit in post-war years.

+	147,000 tons	Haddock	at	340 sh.	per ton			=	50 mill. sh.
—	16,700	»	Halibut	»	1,290	»	»	= ÷	21.5 mill. sh.
—	5,700	»	Plaice	»	570	»	»	= ÷	25 mill. sh.
Total +									25 mill. sh.

Making a profit and loss calculation for the three species, halibut, plaice and haddock, in the Icelandic waters, it may be permitted to use the average price obtained in England, in 1913, as the major part of this catch has been made by English vessels; thus, 1.29 sh., 0.57 sh., and 0.34 sh. per kilo may be used in this calculation, respectively — kilo prices that are lower than any later price in the succeeding years under review.

It must be noted that the equilibriums estimated are definitely fictitious, to some extent based on the diagrams in Paper 17, which in their turn are

derived from Bulletin Statistique, but in no way backed by results from definite scientific investigations. The 25 mill. sh. profit, therefore, may be open to dispute, but taking each species separately, they seem to support the assertion that the temporary protection of longer duration than the critical period (haddock) results in profit; the two periods being even, in a balance (plaice), while a protection shorter than the critical period (halibut) must show considerable losses to the fishery for such species.

STATISTICAL INFORMATION FROM RECENT YEARS

BY

Å. VEDEL TÅNING

Introduction.

At the meeting 6/7 1937 of the "Sub-Committee on the Faxa Bay question", it was decided that enquiries on fishing in Faxa Bay should be addressed to countries interested in the Iceland fishery.¹ In accordance with the resolution a form of questions was sent to the governments concerned in August 1937. It was forwarded to all countries connected with the International Council, in order to procure information also from such countries as might have commenced fishing in the area in quite recent years.

The area for which information was desired, was the Faxa Bay inside a line drawn between Gardskagi (Reykjanes-Skagi) and Malarrið (Snæfellsnes) and the following enquiries were made:

1. Does your country take any part in the fishery carried out in Faxa Bay? The answer being affirmative, please supply information on the following points:
 2. How many fishing vessels from your country visited Faxa Bay in 1936 (if possible also the number for previous years)?
 3. Kindly enumerate the species of food fishes specially sought in the bay by your fishermen.
 4. What regular statistics are available (published or unpublished)?
 5. Total quantity caught in Faxa Bay in 1936.
 6. Total quantity caught in the preceding years (as far back as possible or in some recent years).
 7. Quantity of each species separately if possible.
- Please supply such information as can be given as to:
8. The quantity taken per unit of ship and gear.
 9. The size composition of the catch (e. g. small, medium, large).
 10. Will it be possible during the coming year to improve the statistics from this area in respect of the above-mentioned points?

The replies to the enquiries were requested not later than November 1st 1937; it has not been pos-

¹ Rapp. et Proc.-Verb., Vol. CV, I, p. 23. Copenhagen 1937.

sible, however, to get answers from all countries and several were first obtained in 1938.

The following countries have replied that no fishing has been carried on there by their inhabitants during recent years: viz., Ireland, Latvia and Poland.

Replies have not been received from Spain and Portugal; these two countries do not participate, however, in the Faxa Bay fishery as far as known.

The following countries according to the replies have in recent years fished occasionally or with a few vessels only in the Faxa Bay: Belgium, Finland (herring fishery), France, Holland, Scotland and Sweden.

Fishery of great or not insignificant importance is carried on by the following countries:

Denmark (Faroe cutters), England, Germany, Iceland and Norway.

The statistical data obtained are rather heterogeneous and incomplete and owing to this it has been impossible to give a review of the information in an easily comprehensible manner. Moreover nearly all countries have no special statistics of Faxa Bay as defined in the enquiry, and many vessels work during an Iceland voyage not only in Faxa Bay but also on some other Iceland fishing grounds. Iceland has recently organized detailed statistics to be collected from the area; next to England, which collect fairly exhaustive statistics for an area a little more extended than that defined, Iceland is the most important trawling nation of the area and it will accordingly be possible to obtain a better comprehensive survey of the trawl fishery in the Bay in the future.

Information on the recent fishery in Faxa Bay has been given by ÁRNI FRÍÐRIKSSON in Papers 14 and 15 of this report.

Considering now the different species fished for in the Bay it is apparent that the cod, especially the large and medium sizes, is the main object quantitatively considered in the area in spring and summer; nearly all countries emphasize this species

Table 54. Quantities (tons) landed by English first-class Steam Trawlers and first-class Steam Liners from Faxa Bay, Iceland.

	<i>Steam Trawlers</i>		<i>Steam Liners</i>	
	1932—36	Average	1932—36 ²	Average
Total hours fishing.....	103,136	20,627	?	?
No. of voyages.....	889	178	13 ²	3.3
Days absent.....	17,482	3,496	266	67
	1,000 kgs.	1,000 kgs.	1,000 kgs.	1,000 kgs.
Catfish.....	283—378	347	0.1—0.5	0.1
Cod.....	8,443—9,924	8,933	3.8—52.8	24.9
Dab.....	72—174	114	—	—
Dogfish.....	0.4—4	1.6	0.5—1.1	0.4
Haddock.....	623—1,000	828	0.5—2.0	1.1
Halibut.....	106—178	135	1.6—10.5	5.6
Lemon Sole.....	113—151	132	—	—
Ling.....	20—86	43	3.2—8.6	4.9
Megrim.....	0.7—15	5	—	—
Angler.....	0.2—0.5	0.3	—	—
Plaice.....	284—536	403	—	—
Redfish.....	+ —20	(18) ¹	+ —2.6	(1.4) ¹
Saithe.....	294—644	467	—	—
Skates & Rays.....	27—56	40	2.0—5.3	3.7
Torsk.....	1.2—6.7	2.7	13.0—24.0	18.7
Whiting.....	9—20	13	—	—
Witch.....	5—64	20	—	—
Livers.....	179—833	389	2.3—6.7	4.0
Roes.....	60—211	142	1.2—1.9	1.1
All other (ex. Shell).....	20—60	43	0.1—2.4	0.7
Demersal fish				
Total.....	10,675—14,091	12,064	45—92	66

¹ for 1935 and 36 only. ² excl. 1933 (no voyages).

For the year 1936 a catch of 102 kgs. hake ("small") has been reported as caught in the area; probably these are caught on some other fishing ground as the hake is very rare at Iceland.

as the most important for their fishery in the Bay. This fishery according to available observations is mainly carried out in the central and northern part of the Bay; probably, however, a great part of the catch is actually caught outside the limit Gardskagi—Malarrif.

Among the round fish the haddock comes next; as far as can be seen from the statistics available (English and German), the large and medium haddock are of most importance. The haddock fishery of the Bay is of most importance to England and Iceland.

Saithe and catfish are for the trawlers of some value as a by-product, but these species like the other round fish, not mentioned above, are of relatively small importance to the different fisheries. For Germany the saithe is, however, of importance.

Of flat-fishes the plaice, halibut and lemon sole are outstanding in importance for trawling and Danish seine fishing. Lemon sole belonging to the large market categories is the most common. Of plaice and halibut, however, respectively 60 % and 80 % of the English trawl catches (see Table 55) and probably also of the Icelandic belong to the category "small". In the "medium" category halibut shows but small percentages, plaice, however, about 35 %.

As the statistics obtained by the enquiry are in most cases of a very fragmentary nature, it is not possible generally to compare the value of Faxa Bay with the whole Icelandic area. In Appendix A and B, however, are given the detailed statistical data of 1935 from Iceland fishing grounds according to the "Bulletin Statistique" (1937) and moreover the average quantities for the years 1932—35 of the five principal food fishes (calculated from Bull. Stat. 1933—37).

Comparing the scanty material obtained from the enquiry it is obvious that the quantities fished in the Bay for nearly all countries constitute rather a small fraction of the whole fishery in Icelandic waters, though not for England and Iceland; nor for the cod-fishery of Norway and the Faroes. German trawlers have only made 10 yearly voyages to Faxa Bay out of about 1,450 voyages to the whole Icelandic area.

The special cod fishery carried out by Norway and the Faroes in the area is of much interest. According to the statistics Norway had in 1935 a total catch of ca. 15,000 tons cod on Icelandic grounds, of which about 3,300 tons split salted cod or about 7,600 tons round fish have been caught in Faxa Bay. As to the Faroe fishery in the area and the special interest the Faroe cutters have in this fishery see under Denmark.

Table 55. Quantities and Percentages of the Market Categories of the Principal Species landed by English first-class Steam Trawlers and Steam Liners.

		<i>Steam Trawlers</i>			<i>Steam Liners¹</i>		
		1932—36 1,000 kgs.	Average 1,000 kgs.	%	1932—36 1,000 kgs.	Average 1,000 kgs.	%
Cod	Large	3,389—5,330	4,557	51.0	2—35	16	64.8
	Med.	2,094—3,556	3,070	34.4	1.7—18	8	33.8
	Small	881—1,806	1,307	14.6	0—0.9	0.3	1.4
Haddock	Large.	256—495	356	43.0	0.5—2.0	1.1	100
	Med.	181—334	256	30.9	—	—	—
	Small	134—311	216	26.1	—	—	—
Halibut	Large.	10.5—14.6	13.1	9.7	0.5—5.1	2.4	42.7
	Med...	10.7—15.1	12.6	9.4	0.4—3.1	1.9	33.6
	Small.	84.7—140.7	109.1	80.9	0.8—2.3	1.3	23.6
Lemon Sole	Large.	67.6—82.2	75.7	57.3	—	—	—
	Small.	41.6—72.2	56.4	42.7	—	—	—
Plaice	Large.	11.4—30.2	20.8	5.2	—	—	—
	Med...	89.1—194.9	144.2	35.8	—	—	—
	Small.	179.1—318.2	238.0	59.0	—	—	—
Megrim	Large.	0.7—14.3	5.1	96.2	—	—	—
	Small.	0.0—0.8	0.2	3.8	—	—	—
Witch	Large.	4.8—54.0	17.1	86.2	—	—	—
	Small.	0.0—10.4	2.7	13.7	—	—	—

¹ Excl. 1933.

Statistical Data.

Belgium.

Belgian vessels only exceptionally work in Faxe Bay and in the statistics the catch is not separated for this area but is included in the total quantity from Iceland according to the rules adopted by the Statistical Committee of the International Council.

Denmark.

Danish seine fishing is not allowed to Danish citizens in territorial waters of Faxe Bay according to the present regulations; the extraterritorial area in question does not afford suitable localities for this implement.

Practically all Faroe cutters carry out cod fishing in the Faxe Bay in the later part of the spring season, when the fishing off the south coast has come to an end and no profitable fishery can be carried on in other Icelandic areas. During the years 1936 and 1937 about 160 Faroe fishing vessels have participated in this fishery with long line and especially with hand line. The catch consists mainly of cod of medium size and of codling. The total catch from the Bay cannot be stated; during years when the south coast fishery has given high quantities this fishery is of smaller importance; on the other hand, when the south coast fishery has been bad the Faxe Bay fishery is of much importance, e. g. in the years 1936 and 1937. The statistics give no particulars, but the catch per vessel per annum may be estimated at ca. 10 tons for 1936 and for 1937.

According to the facts stated the Faxe Bay fishery is of more importance than actually seen from the quantities mentioned, as the Faxe Bay is practically the only fishing ground the vessels use in late spring.

England.

The principal foreign fishing in Faxe Bay is carried out by England.

Detailed statistics (not published) are available for an area somewhat larger than the area of Faxe Bay as defined in the questionnaire; the area is given in Fig. 27. It is not possible to give figures in respect of Faxe Bay as defined in the questionnaire. The principal fishing is, however, carried out inside the limit Gardskagi—Malarrif and the particulars give a fairly good idea of the importance of the area.

The number of English fishing vessels visiting Faxe Bay is not known, but the statistical tables show the number of voyages in each year, in the years 1932—1936 between 157 and 197 per annum, with an average for 1932—36 of 178 voyages per annum.

For the years 1932—1936 a review of the particulars is given (in 1,000 kgs.) in Tables 54 and 55. The particulars of steam trawlers and steam liners are given separately; the catch of the steam liners is, however, of small importance compared with the steam trawlers. The average total catch per annum in the period 1932—36 taken by steam trawlers is

12,064 tons or an average of about 68 tons per voyage. The cod, haddock, saithe and plaice each exceeding 400 tons per annum, the cod outstanding with about 9,000 tons per annum. Catfish, halibut, lemon sole and dabs yield 100—350 tons per annum; all other species below 50 tons per annum.

The catch per voyage, per day's absence or hour's fishing can for each species be calculated from the data given; as, however, no comparison is possible with the catch of other countries these particulars are omitted here.

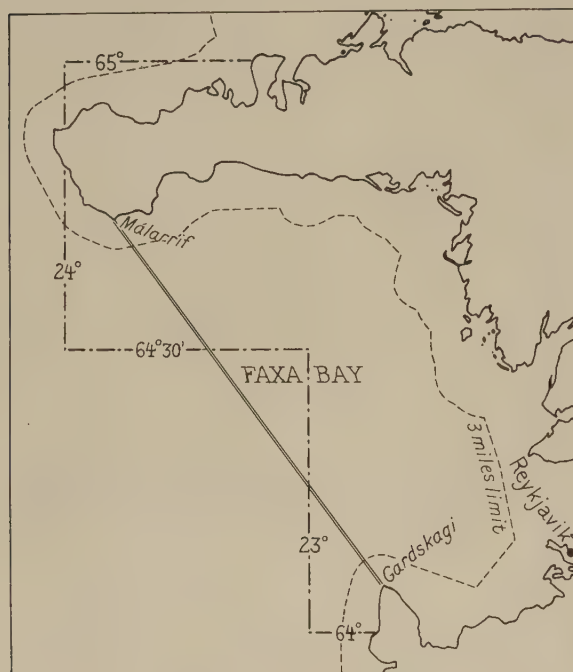


Fig. 27. Statistical Areas.

Figures for English Landings relate to the Area within the broken line ——— Landings from all other countries are uncertain as to area, probably within the line Gardskagi—Malarriif. — The extraterritorial area of Faxe Bay within the line between Gardskagi and Malarriif is about 810 naut. sq. miles.

For England the following percentages of the principal five species landed from Iceland grounds 1935 have been caught in Faxe Bay (as defined in the English statistics):

Cod.....	7.2 %
Haddock....	5.0 %
Halibut.....	6.2 %
Plaice.....	10.7 %
Lemon Sole .	6.6 %

It is obvious from these figures that the Bay plays a great rôle in the British fishery on Icelandic grounds.

The average value per annum (in the period 1932—36) of the catch of both steam trawlers and

liners is given below in shillings for the principal food fishes. The average price per kg. is calculated from the international statistics 1932—35¹.

	Cod	2,149,866 shillings
	Haddock....	339,766 »
The average value	Plaice	370,691 »
of catch per annum	Halibut.....	175,658 »
	Lemon Sole	149,273 »

Table 55 gives a review of the size categories of the catch of the principal fishes for which such particulars are available (i. e. cod, haddock, hake, halibut, lemon sole, megrim, plaice, witch).

Apart from the fact that the area in the English statistics is not defined as in the questionnaire, the particulars given are very exhaustive and it is stated that it will not be possible during the coming year to improve the statistics.

Finland.

In recent years Finland has only been working in the Faxe Bay once, i. e., during September 1936; the object of the fishing was herring and the catch was infinitesimal.

France.

French vessels only exceptionally work in the Faxe Bay inside the line Gardskagi—Malarriif, and the number of vessels frequenting the Bay during 1936 has been insignificant as in the preceding years. Sometimes hauls are made in the area off Snæfellsnes, but after 1935 less and less frequently owing to the decrease in the stock of fish. The total quantity caught in the Bay is included in the total Iceland catch and not kept separately in the statistics. It has not, however, been possible to get information from all vessels which have probably been working in Faxe Bay in recent years.

Germany.

Some fishing has been carried out by German trawlers in the Faxe Bay during the years 1927—1932 and during 1935—1936. A total of about 12 voyages were carried out in 1935 and 1936 with the Faxe Bay as the principal fishing ground; on 4 voyages the Faxe Bay was partly included in the fishing operations. Most probably some fishing has, however, been carried out in the Bay by some trawlers which have not reported this to the statistics. The number of voyages may therefore be estimated as about 10 per annum during the years 1935 and 1936.² The total number of voyages to the whole Icelandic area was in 1935 and 1936 2,898 voyages, i. e., about 1,450 voyages per annum.

¹ Cod 0.24 sh. pr. kg., haddock 0.41, plaice 0.92, halibut 1.25, lemon sole 1.13.

² According to later information obtained the Bay was not frequented by German trawlers in 1938 (Hagmeier).

The principal fishes taken in Faxa Bay are cod, (*Gadus callarias*), Norway haddock (*Sebastes*) and saithe (*Gadus virens*); all other species being of minor importance.

Statistical particulars from the area are, however, not available and not published.

The total catch in Faxa Bay taken by German trawlers may be estimated as follows:

1927—1932 not more than	785,000	kgs.	per annum
1935 " " "	350,000	" " "	
1936 " " "	960,000	" " "	

No particulars are available as to the quantities of the different species of food-fishes taken in the Bay; this is also the case as to the quantity taken per unit of gear etc.

Some particulars are available as to the size composition of the catch from Faxa Bay; the following table gives the average relative occurrence (in %) of the different market categories.

Market categories	I	II	III	IV
Cod (<i>Gadus callarias</i>).....	62	35	3	—
Haddock (<i>Gadus aeglefinus</i>).....	60	28	7	5
Saithe (<i>Gadus virens</i>).....	65	35	—	—
Catfish (<i>Anarhichas lupus</i>).....	78	22	—	—
	38		62	
Plaice (<i>Pleuronectes platessa</i>).....	18	47	15	20
Lemon Sole (<i>Microstomus kitt</i>).....	44	56	—	—
Dab (<i>Limanda limanda</i>).....	100	—	—	—
Megrim (<i>Lepidorhombus whiff-iaonis</i>)	12	19	42	27
Halibut (<i>Hippoglossus hippoglossus</i>)..	93	7	—	—
Skates and Rays (<i>Rajidae</i>).....				

It will be rather difficult also in the future to get statistical particulars from the Faxa Bay as defined, because the fishery in the area is not of a regular but of a more occasional nature; measures have, however, been taken to make improvements.

Holland.

Previously there has been an important fishery in the area, in recent years declining.

During the years 1934—37 Dutch trawlers have not been fishing at Iceland in 1935 and 1936 and probably not in 1937. In 1934 trawlers made two voyages from IJmuiden to Iceland in February and March; each voyage was of 23 days' duration and the total catch 79,865 kgs. (value f. 6,237.-); it is, however, not known if the trawlers worked in Faxa Bay or not. The trawl-fishing in Iceland waters will probably be reviewed in the near future.

Iceland.

The fishery carried out in the Faxa Bay is of great importance for Iceland.

No complete statistics are, however, available as to the number of fishing vessels visiting the Bay, but taking the home-ports and the fishing gear of Ice-

landic fishing vessels into consideration, the result is obtained that about 150—200 vessels or ca. 25 % of all Icelandic fishing vessels, have visited the Bay in 1936, and about the same number in the previous years.

There are four kinds of fishing carried on in Faxa Bay, viz.:

a) Long-line fishery, in December—May, especially for mature cod.

b) Trawl-fishery covering the greatest part of the year, especially seeking *Pleuronectids* except in January—May, when ripe cod are sought.

c) Danish-seine fishery from May 15th to November 30th, for *Pleuronectids* and haddock.

d) Handline-fishery in the summer months. This fishery is of very little importance, and is mainly for codling.

No published statistics are available. In the Journals of the Fisheries Association of Iceland, there is a fairly good supply of information as to the quantity and quality of the different species of food-fishes taken by the trawlers. These statistics also give information as to the time of fishing. Material was provided recording where each trawler had been fishing during some years, and by combining the data it was found, that practically no trawling takes place in the Bay proper during the cod fishing season.

It is hoped in the coming years to improve the statistics from this area in respect of the questions of interest to the present investigations (see Paper 15).

Ireland. Vessels from the Irish Free State do not fish in Icelandic waters.

Latvia. No fishing is carried out in the Area.

Norway.

The Faxa Bay is the Iceland Area most frequented by Norwegian line vessels fishing for cod; the causes of this are that the Bay is rather well stocked with fish and furthermore that the bottom conditions are ideal and the weather of a certain stability.

Detailed statistics are not available. During the years 1930—1936 about 47 cod fishing vessels have, however, had a yearly catch of about 70 tons "saltfish" (split, salted cod) pr. vessel, giving a total yearly yield in the area of 3,300 tons "salt-fish", the value on an average being 709,500 Kr. per annum (roe and oil not included).

Poland. No fishing is carried out in the Area.

Portugal. No particulars received; as far as known no fishing has been carried out in the Area for many years.

Spain. No particulars received.

Scotland.

During the years 1934, 1935 and 1936 the records of the Fishery Board for Scotland show only one arrival of a British fishing vessel at a Scottish port from the Faxe Bay. The arrival was made in July 1935 by a Scottish steam trawler which had also fished in other areas of Iceland during the same voyage and the particulars of the catch taken in the Bay cannot therefore be ascertained.

Sweden.

In 1937 seven Swedish fishing boats using Danish seine have carried on fishing in the Faxe Bay; the total catch is estimated at about 160—175 tons. The principal species caught is the witch (*Glyptocephalus cynoglossus*), however, also a small amount of haddock. Only large fish are taken as the mesh of the Danish seine used is a large one (45 mm. between centre of knots).

Appendix A.**Total Quantities (in 1,000 Kilos) of Demersal Fish landed from all Iceland Grounds in 1935¹.****Gadidae.**

Countries	Cod <i>Gadus call.</i>	Haddock <i>Gadus aeglef.</i>	Saithe <i>Gadus vir.</i>	Whiting <i>Gadus merl.</i>	Ling <i>Molva</i>	Torsk <i>Brosme</i>
Belgium.....	1,283	342	336	62	79	4
Denmark.....	130	569	—	—	—	—
Faroe Isl.....	28,776	35	—	—	—	—
England.....	127,870	15,635	11,186	627	1,438	591
Finland.....	—	—	—	—	—	—
France.....	6,218	99	—	—	—	—
Germany.....	37,888	3,500	26,345	387	3,279	609
Iceland.....	182,926	6,313	5,628	4	2,850	312
Latvia.....	—	—	—	—	—	—
Norway.....	15,284	—	—	—	—	—
Scotland.....	1,516	245	71	80	130	165
Sweden.....	—	—	—	—	—	—
Total.....	401,891	26,738	43,566	1,160	7,776	1,681
% of total						
N.W.-European catch.	39.9	14.7	29.6	1.6	23.0	13.6

¹ Vide "Bulletin Statistique", 1937.

Pleuronectidae.

Countries	Plaice <i>Pleur. plat.</i>	Lemon Sole <i>Microst. kitt.</i>	Witch <i>Glyptoceph. cynogl.</i>	Dab <i>Limanda lim.</i>	Halibut <i>Hippogl.</i>	Megrim <i>Lepidorh. whiff-iag.</i>
Belgium.....	11	16	—	8	12	—
Denmark....	343	78	90	12	18	8
Faroe Isl....	28	1	—	—	3	—
England.....	4,094	1,989	306	574	1,919	36
Finland.....	—	—	—	—	—	—
France.....	—	—	—	—	—	—
Germany....	45	187	808	7	293	338
Iceland.....	796	35	7	26	382	1
Latvia.....	—	—	—	—	—	—
Norway.....	—	—	—	—	82	—
Scotland....	20	60	18	18	109	2
Sweden.....	—	—	—	—	—	—
Total.....	5,337	2,366	1,229	645	2,818	385
% of total						
N.W.-European catch	7.0	24.4	21.7	6.0	22.1	5.5

The statistics from Icelandic grounds give for 1935 63 tons (1.2 %) breem (Germany 55, Iceland 8) and 17 tons hake (England 7 and Iceland 10). The first-mentioned species may possibly be *Sebastes*, whereas hake is too rare in the area to appear in commercial catches.

Appendix A continued.

Other species.

Countries	Norway Haddock <i>Sebastes</i>	Catfish <i>Anarhichas</i>	Monk <i>Lophius</i>	Dogfish etc. <i>Acanthias</i>	Skates & Rays	Various
Belgium.....	275	20	7	4	25	035
Denmark....	—	7	—	—	4	21
Faroe Isl....	—	1	—	—	—	2
England.....	1,598	8,776	32	270	680	6,981
Finland.....	—	—	—	—	—	—
France.....	—	—	—	—	—	—
Germany....	18,440	425	117	428	297	4,416
Iceland.....	4,002	770	1	1	101	11,843 ¹
Latvia.....	—	—	—	—	—	—
Norway.....	—	—	—	—	—	—
Scotland....	—	29	1	—	152	47
Sweden.....	—	—	—	—	—	—
Total.....	24,315	10,028	158	703	1,259	23,345
% of total						
N.W.-European catch.	57.3	72.6	1.8	2.8	3.0	—

¹ Incl. 10,997 tons = Liver, Roe, Fishoil.

Appendix B.

Quantities (in 1,000 Kgs.) of the Five Principal Demersal Food Fishes landed from all Iceland Grounds.

Averages for the years 1932—35.¹

Countries	Cod	Haddock	Halibut	Plaice	Lemon Sole
Belgium.....	1,037	228	10	5	9
Denmark.....	112	438	19	372	100
Faroe Isl.....	37,835	53	3	40	2
England.....	129,483	15,786	2,017	3,977	1,905
France.....	13,881	195	—	—	—
Germany.....	47,817	5,203	310	141	222
Holland.....	163	17	0.3	0.5	2
Iceland.....	215,516	5,467	343	685	53
Norway.....	12,455	—	126	—	—
Scotland.....	2,707	273	147	27	44
Sweden.....	1	10	0.3	16	2
Total.....	461,007	27,670	2,975.6	5,263.5	2,339
% of total					
N.W.-European catch.	44.3	13.9	21.1	6.6	24.3

¹ Calculated from "Bulletin Statistique".

SUMMARY OF THE CATCHES OF THE MOST IMPORTANT DEMERSAL FISHES AT THE
FIXED TERRITORIAL AND EXTRA-TERRITORIAL STATIONS WITHIN THE FAXA BAY FROM
1924 TO 1937 WITH A SUPPLEMENT FROM LATER YEARS

BY

A. STRUBBERG

In 1924, onboard the "Dana", the late Professor JOHS. SCHMIDT started his special trawling investigations at two fixed stations within the Faxe Bay, in territorial and extra-territorial waters respectively (Rapp. et Proc.-Verb., Vol. XXXIX). Since then the investigations have been continued fairly regularly with the assistance of research vessels from Iceland, Great Britain, and Holland, — during 1927 to 1929 as "Quarterly Stations" investigated by the Icelandic patrol vessel "Thor", — in other years trawlings were carried out at various seasons each year, as shown in Table 8, Paper 3.

The central positions of the two fishing grounds are: —

in territorial waters: 64°04' N. 22°35' W.
in extra-territorial waters: 64°08' N. 22°23' W.

The depth at each station is about 30 to 35 m. The extra-territorial station is situated on a ground much frequented by trawlers; it was the object of the investigations to establish a basis for comparing size and composition of stock in an area overfished by trawlers with that on the adjoining territorial ground where trawling is prohibited.

From the beginning of the investigations (1924) the "Dana" used a 50-foot otter-trawl with small-mesh-net covering¹ ([Aberdeen cod trawl], denoted by O 50 in the tables) in hauls of 1-hour duration. Generally, 10 to 20-hour trawlings were carried out every year at each of the two stations.

The other vessels, however, co-operating in the ensuing years have mostly used a larger trawl. Thus: —

The total number of hours trawling for all research vessels taken together for 1924—1937 was 437 in territorial waters and 440 in extra-territorial waters.

As to the five most important demersal (bottom) fish the material contains the following total number for (a) territorial and (b) extra-territorial waters respectively.

	Plaice	Cod	Halibut	Lemon Sole	Haddock
(a) abt.	28,300	4,300	3,150	4,300	32,000
(b) abt.	6,500	5,150	2,150	1,700	5,560

With the exception of the cod, the catches for the whole period were thus much greater within the territorial waters than outside (cp. JOHS. SCHMIDT, Rapp. et Proc.-Verb., Vol. LXVI, p. 99).

In the following, a general view is given of the catches, in the individual years (and seasons) of the above-mentioned five demersal species, by summarizing their quantity-index (mean number per 1-hour trawling) and average size.

In order to compare the catches per 1-hour trawling at each of the two stations the material has been compiled in the tables for every year (and month) and arranged by 5-cm. groups for each species.

The quantity-index and the average size are given for each species and sample. The percentage of the catch in each sample below the minimum size proposed by the London Conference in 1937 has been given, i. e. for plaice and lemon sole 23 cm., for cod and haddock 24 cm.

Tables 56—69 and Figs. 28—33 on pp. 99—114.

	Head- line	Foot- rope
"Thor", 1927—29: O 50, viz., same as "Dana"		50'
"", 1931—37: VD 75, viz., Vigneron Dahl commercial trawl	75'	
"George Bligh", 1936: CT 120, viz., commercial trawl		120'
"Nautilus" 1936: VD 38.5, viz., Vigneron Dahl commercial trawl		38.5 m.
"", 1937: CT 38.5, viz., commercial trawl		38.5 m.
"Explorer", 1925: CT 128, viz., commercial trawl with small-mesh-net	(60')	128'
"", 1925: O 50, viz., 50 f. Otter-trawl with small-mesh-net		50'

¹ The content of the small-mesh-net not included in the calculations. Means not corrected by + 0.5 cm

A. Plaice.

Seasonal Catches, "Quarterly Stations", 1927—1929. (Table 56.)

Fig. 28 gives the seasonal changes in the density of the stock (and the size distribution) from the three years. The figure shows the variations within a short period — partly as a result of the wanderings and the growth of the stock, partly influenced by the natural conditions (wind, current, etc.) which determine the yield in every single instance.

Although highly different, all samples clearly show greater — and sometimes even much greater — numbers per 1-hour trawling within than without the territorial limit and thus confirm the importance of the innermost part of the Faxe Bay as a nursery ground for plaice.

Summer Catches in 1924 to 1937. (Tables 57—58.)

Figs. 29 and 30 give samples from the "Dana" stations in 1924—27 and 1931—34, supplemented by material from the "Explorer" (1925) as well as "George Bligh", "Nautilus", and "Thor" (1936 and 1937).

"Dana" stations 1924—1931 (Fig. 29). In all these years a considerable stock of immature plaice is met with in *territorial* waters, whilst the catches in extra-territorial waters do not show any corresponding numbers. In the three following years, however, 1932—34, and specially in 1932—33, conditions have changed.

The average numbers per 1-hour trawling are the following: —

Period	1924—1929	1931—1934
territorial waters	88.0 12	66.0 3.2
extra-terr. waters	$\frac{7.5}{1}$	$\frac{21.0}{1}$

At later summer stations, in 1936 and 1937 ("Thor" did not trawl in extra-territorial waters in 1936), we find relatively even still larger numbers in extra-territorial waters.

The averages for 1936—37 are

in territorial waters	68	1
in extra-territorial	$\frac{71}{1}$	$\frac{1}{1}$

Expressed in percentage of the total number per 1-hour trawling in both waters the territorial catches were as follows: —

1924—29	1931—34	1936—37
about 92 %	about 76 %	about 50 %

These values may be considered to express a definite change in the density of the stock within and without the territorial limit. It seems justified to suppose that this change is a result of the changed conditions which the practical fisheries have experienced since 1929—30, such as the introduction of the intense Danish seine fishery. As early as 1933 and 1934, Dr. TÅNING has called

attention to this change in the density of the territorial as well as extra-territorial stock (Rapp. et Proc.-Verb., Vol. LXXXV, p. 16 and Vol. LXXXIX, p. 19). More recent data prove that these changes cannot be explained by accidental variations in conditions; they are of such practical importance that their development will have to be followed through regular investigations in future.

With regard also to the average size of the individual sample changes can be proved in the period under review. It suffices here to point out to the following values which show a substantial decrease for 1931—34 in the average sizes of the samples: —

	1924—1929	1931—1934
territorial.....	about 30.3 and 32.4 cm.	22.1—28.3 cm
extra-territorial	» 33.3 » 34.5 »	28.0—32.8 »

The "George Bligh" samples show corresponding values.

The 1937-catches were taken in May and October and are not thus quite suitable for a comparison with the above figures.

	Average sizes in 1937	
	May	October
territorial.....	26.6—33.1 cm.	33.5 cm.
extra-territorial.....	29.5—27.0 »	33.0 »

But also here some figures are below the average values for 1924—29.

The 1937-samples seem to show that the average lengths are about to increase; further investigations will have to prove whether this increase is temporary or not.

B. Haddock.

Seasonal Catches, "Quarterly Stations", 1927—29 (Table 59.)

Only the territorial catches are fairly numerous. Cp. Fig. 31.

During the summer and autumn catches in 1927 and 1929 relatively important occurrences of young fish (I and II-group) were noted in the Bay *within* the territorial limits, not so, however, in 1928. Earlier in the year the trawlings gave but a few stray specimens.

It may be worth mentioning that it is of course far more difficult, in relatively few hours trawling, to procure representative samples of an existing stock of round fish than of that of flat fish. Moreover there can hardly be any doubt that, with round fish also, the difficulties are greater in the case of cod than of haddock.

Summer Catches in 1924—1937. "Dana" Stations in 1924—1934. (Tables 60—61.)

The figures of the catches prove the importance of the territorial area as a nursery ground. See Fig. 32.

From the quantity of fish per 1-hour trawling it can be seen that the density of the stock varies

considerably from one year to the other, decreasing from 1924 to 1931 and again increasing during the later years of the period under review. This latter rise can be attributed to the occurrence of some specially good year-classes, among others that of 1931 (cp. RAITT, Fisheries, Scotland, Sci. Invest., 1936, No. 1, p. 15).

The fluctuations in the extra-territorial quantities are less conspicuous in 1924—27, and the actual quantities much smaller than in the next period (1931—34).

The quantitative decrease at the territorial station, observed by Dr. TÄNING (loc. cit.) from 1924—27 to the beginning of the 'thirties, was temporary only and due to the fluctuations in year-classes; thus Table 60 gives 135 fish per hour in 1933 and 374 in 1934, but like the plaice-survey the "Dana" catches show that the proportion between the quantities of haddock caught in territorial and extra-territorial waters has been subject to changes from period 1924—27 to period 1931—34.

Haddock caught per 1-hour trawling					
	1924—1927	1931	1932	1933	1934
territorial	10—14	1	2	2	6
extra-territorial ..	1	1	1	1	1

It is as yet quite impossible to say whether this change may be regarded as an indication of a long duration influence on the stock caused by the above-mentioned changes in the methods of the practical fishery (introduction of intensive Danish seine-net fishing on the territory).

Stations in 1936 and 1937.

At these stations the territorial stock is numerically absolutely superior and conveys a strong impression of how important the territorial area still is as a nursery ground; outside the limits the haddock is rapidly outfished. See Fig. 33.

C. Halibut.

Seasonal Catches, "Quarterly Stations", 1927—1929.

The small quantities (Tab. 62) do not permit conclusions to be drawn. No size difference can be proved between (a) territorial and (b) extra-territorial catches. The average sizes were: —

- (a) ... from 23.1 to 36.2 cm., mostly 29.5 to 32.5 cm.
 (b) ... » 24.3 » 34.7 cm., » 29.3 » 33.0 »

One single extra-territorial sample, March 1927, showed an average record as low as 14.7 cm.

Summer Stations in 1924—1937.

(Tables 63—64.)

Quantities per trawling-hour		
	1924—1929	1931—1934
territorial.....	8.5	4.4
extra-territorial.....	5.2	7.2

In spite of the quantities being small they seem — as in the case of plaice — to prove a decrease

in the density of the stock in territorial waters, and an increase in extra-territorial waters.

Average lengths of the two periods.		
	1924—1929	1931—1934
territorial.....	29.9—36.6 cm.	24.0—30.0 cm.
extra-territorial....	25.0—34.7 »	26.2—29.5 »

In the samples from 1936 and 1937 the lengths vary very much.

Quantities per trawling-hour						
	1936	1937				
	2/6	5/7	18/7	24/5	26/5	28/10
territorial.....	14.5	15.2	29.6	30.1	9.0	7.2
extra-territorial....	0.5	57.8	—	3.3	19.5	6.2

The samples from 2/6 1936 and 24/5 1937 show a relatively important territorial preponderance. Later in the summer the proportion is changed, but corresponds to the proportion in 1931—34.

It is evident that here also continuous observations must be carried on so that we can follow the stock throughout the year as to movements of stock and density fluctuations.

D. Cod.

Tables 65—67.

The 50-feet otter-trawl, as mentioned above, is hardly suitable for representative catches of cod. The "Dana" samples, consequently, consist generally of very small quantities only.

This holds good for "Thor"'s samples from previous years. In 1936 and 1937, however, several larger samples were taken.

1936		1937		
	5/7	24/5	26/5	28/10
territorial, per 1				
hour.....	94.8	2.4	336.0	27.8
average size....	48.1 cm.	27.7 cm.	49 cm.	71.8 cm.
extra-territorial,				
per 1 hour...	35.5	122.0	60	16
average size..	27.7 cm.	49.4 cm.	53.6 cm.	53.8 cm.

On the whole, the material of this highly migratory fish does not give rise to any special observations.

E. Lemon Sole.

Tables 68—69.

The small catches of this species neither give rise to special conclusions. It must be mentioned, however, that the "Dana" catches made in territorial waters in 1924—29 and 1931—34 show a decrease in quantities per trawling hour as well as in average size — similar to the plaice (for later years see RAE's paper, No. 11).

	1924—1929	1931—1934
territorial, per 1 hour.....	9.9	8.2
average size.....	31.5 cm.	27.7 cm.
extra-territorial, per 1 hour....	1.3	11.0
average size.....	31.4 cm	28.6 cm.

Both territorially and extra-territorially the average size has decreased and the proportion between quantity per trawling hour has changed from one period to the other.

At the summer stations in 1936—37 (Nu, G, GB, Th) the quantities are materially greater, owing to the gear used; they are divided as follows: —

	1936		1937		
	2/6	5/7	23/5	25/5	28/10
territorial.....	17.5	188.0	47.5	20.5	24.9
extra-territorial.....	18.0	102.0	22.4	6.0	0.8

Thus generally, the proportions are similar to the "Dana" samples from 1931—34.

It cannot be disputed, that continued observations at the fixed stations would be of great importance and give a solid basis in following the influence of the practical fishery on the stocks — one of the chief aims of fishery investigations.

In these investigations the flat-fish stocks must be of prime interest on account of their economic

importance and because they give the best chances for obtaining representative samples in the gear. The haddock stock comes next, as it offers somewhat similar possibilities of investigation.

Even if the Faxe Bay be subject to an experimental closure it is of course of utmost importance that future work be planned with regard to continuity as well as to the greatest uniformity of gear and methods generally in order to secure the best possible basis for conclusions and thereby getting the full benefit of the continued investigations on these lines.

The above summary proves the necessity of systematically arranged investigations, and the examples given above of how conditions change with the seasons make it clear that investigations at different seasons must be part of the programme.

If a working programme can be arranged for a series of hauls at both stations three or four times every year, viz., during the months Febr./March—April/May — July/Aug.—October — the best prospects of satisfactory results might be expected.

Supplement.

Dec. 1946

(Tables 57 a—69 a.)

In the years 1938—1940 and again in 1945 the investigations in Faxe Bay were continued in territorial and extra-territorial waters respectively, with the assistance of various vessels, both Danish and Icelandic research vessels as well as Icelandic trawlers. Table 8 (Paper 3) gives the distribution of the above-mentioned research trawlings for each month within the period. The abbreviations used for the vessels in Tables 57 a to 69 a are as follows:

Th="Thor", Da="Dana", Br="Bragi", R="Reykjaborg", Sk="Skálafell".

While, as in previous years, the "Dana" used a 50-foot otter-trawl, and, as in 1931—37, "Thor" used a Vigneron-Dahl commercial trawl with a 75 feet headline, "Skálafell" and "Bragi" both used a 65 feet commercial trawl and "Reykjaborg" a 90 feet one.

Besides the trawlings shown in the tables "Thor" made a single haul on the 26th June 1938, and on July 25th—26th, 1939, S/T "Geir" carried out some research trawlings which have not been used in this survey. This also applies to some experiments with a Danish seine cutter carried out on the 26th July 1939.

Unlike the period 1927—1929 "quarterly stations" were not established in the years 1938—1945 but the seasonal distribution of the stations is the following: summer 6, spring 3 and autumn 3.

The total number of trawling hours for all participating vessels for the years 1938—40 and 1945 was 100 in territorial waters and 103 in extra-territorial waters, i. e. hardly one fourth of the total numbers of trawling hours in 1924—1937.

With regard to the most important 5 demersal fish the catches in (a) territorial and (b) extra-territorial waters were (in numbers):

	Plaice	Cod	Halibut	Lemon Sole	Haddock
(a) ...	12,420	10,477	2,525	2,918	21,298
(b) ...	6,471	3,309	1,561	386	5,568

It will be seen that in proportion to the trawling hours the figures are higher for all 5 species and, in some cases, considerably higher, than in 1924—1937 (vide above, p. 92), for one thing on account of the gear used.

It holds good of all species that within the period as a whole the largest catches were made in territorial waters as in 1924—37, though in this period with the exception of cod. The proportion between the number of territorial and extra-territorial catches will appear from the following.

I 1924—37:	Plaice	Cod	Halibut	Lemon Sole	Haddock
territ.	4.4	0.8	1.5	2.5	6
ex. territ.	1	1	1	1	1
II 1938—45:					
territ.	2	3.2	1.6	7.2	4
ex. territ.	1	1	1	1	1

Accordingly — during period II — less plaice but more lemon sole and cod were caught in the territory than in previous years.

In the supplementary tables the catches for each station have been given according to size, quantity-index per one hour haul, average size etc. Comments on the tables are given below.

A. Plaice.

The summer stations showed the following average numbers per 1-hour trawling:

Year	1938		1939		1945	
territ. waters	57.7	$\frac{4.5}{1}$	146.1	$\frac{5.8}{1}$	50.8	$\frac{1.9}{1}$
ex. territ. „	12.8	$\frac{1}{1}$	25.3	$\frac{1}{1}$	26.3	$\frac{1}{1}$

With the exception of 1939 the territorial numbers thus show a continued decrease from the previous periods. In 1939, however, both summer stations gave considerably higher numbers — particularly the May station (abt. 253) — the number of which has only been exceeded by the June station in 1925 (750).

In 1938 and 1939, as in previous years, by far the greatest stock was found in territorial waters. Similar conditions were found 1945 in May (abt. $\frac{59}{4}$) whereas the September station gave $\frac{42.5}{48.7}$.

At the spring stations were found:

Year	1938		1939		1945	
territ.	159.2	$\frac{1.9}{1}$	267.1	$\frac{1.2}{1}$	216.1	$\frac{7.7}{1}$
ex. territ.	83.2	$\frac{1}{1}$	218.5	$\frac{1}{1}$	28.7	$\frac{1}{1}$

Year 1927—1929 (Feb.—March).

territ.	51.5	$\frac{3.6}{1}$
ex. territ.	14.4	$\frac{1}{1}$

Thus in both places the numbers in 1938—45 were far greater than in 1927—29, and the output was always larger territorially than extra-territorially — particularly in 1945.

At the autumn stations (November and December) the proportions were the following:

Year	1938		1940		1945	
territ.	215.5	$\frac{1.5}{1}$	18.3	$\frac{0.4}{1}$	19.9	$\frac{0.4}{1}$
ex. territ.	143.7	$\frac{1}{1}$	50.6	$\frac{1}{1}$	51.7	$\frac{1}{1}$

Year 1927—29 (Oct.) 1937 (Oct.)

territ.	30.7	$\frac{6.6}{1}$	67	$\frac{1.2}{1}$
ex. territ.	4.7	$\frac{1}{1}$	58	$\frac{1}{1}$

While in December 1938, as in the spring of 1939, a dense stock could be found in the territory and outside it, the territorial number in 1940 and 1945 was very small. In extra-territorial waters, however, the stock seems to have been considerably larger in both the latter years.

The territorial catches, expressed in per cent of the total number per 1-hour trawling in both places, were the following:

Year	1938	1939	1940	1945
Summer st. . .	81.8	85.3	—	65.9
Spring st. . .	65.7	55.0	—	83.3
Autumn st. . .	60.0	—	26.5	27.8
Year	1927—29	1931—34	1936—37	
Summer st. . .	92	76	50	
Spring st. . .	78.2	—	—	
Autumn st. . .	82.3	—	54.7	

The few stations investigated in the years after 1938 do not give a solid basis for further conclusions, but the average numbers calculated (per 1-hour haul) indicate that the change in the density of the stock, which was found in the period 1924—37, could still be traced in 1938. 1939 shows increasing density; but records from the war years are unfortunately not available. The summer stations in 1945 again showed a low territorial number — lower than the values previously found.

The average sizes in cm. in each sample were the following:

Year	1938	1939	1945
Summer st.			
territ.	26.5—24.1	24.9—25.7	30.4—30.2
ex. territ.	31.2—33.3	28.7—32.0	35.5—32.4

Territorially the average sizes in 1938 and 1939 are nearly the same as in the samples from 1931—34, i. e., considerably lower than in 1924—29. The catches in 1945, however, show an increase in the average size up to about the values found in the first years of research. Extra-territorially something similar also holds good. The rise may be due to a decrease in the stock caused by fishing and, possibly, to differences in the gear used.

At the spring stations the average sizes vary as follows:

Year	1938	1939	1945	1927	1928	1929
territ.	27.4	24.7	28.0	33.0	24.9	31.0
ex. territ.	27.0	30.4	26.5	27.0	28.2	30.9

Here in most of the samples the average size in 1938—45 is also lower than in 1924—29.

The autumn stations showed considerably higher average sizes:

Year	1938	1940	1945
territ.	31.0	34.6	33.2
ex. territ.	29.0	34.2	34.5

Contrary to those given earlier in the present paper the above measurements do not differ much from previous stations:

Year.	1927	1928	1929	1937 (all October)
territ.	31.0	33.3	33.5	33.5
ex. territ.	33.5	33.8	33.6	33.0

B. Haddock.

Summer catches. Average numbers per hour at the individual stations were:

Year	1938		1939		1945	
territ.	325.7	$\frac{41.5}{1}$	565.8	$\frac{38.6}{1}$	282.2	$\frac{410.0}{1}$
ex. territ.	46.9	$\frac{12.1}{1}$	1.8	$\frac{9.1}{1}$	18.9	$\frac{359.8}{1}$
= ca.	$\frac{7}{1}$	$\frac{3.4}{1}$	ca. $\frac{314}{1}$	ca. $\frac{4}{1}$	ca. $\frac{15}{1}$	$\frac{1.2}{1}$

As in previous researches, the figures prove the importance of the territory as a nursery ground,

and the high average figures at most of the stations do not indicate any decrease in the stock of young fish since the start of these researches. As during earlier investigations most catches outside the territory have been small.

The spring stations gave the following numbers:

Year	1938	1939	1945	1927	1928	1929
territ.....	34.4	364.3	1.7	0	3.2	1.8
ex. territ..	0.7	1.0	1.9	2.7	0	0

Accordingly, as early as in February/March 1939 there must have been a considerable stock of young haddock inside the territorial limit.

The autumn stations gave numbers as below:

Year	1938	1940	1945	1927	1928	1929	1937
							(Oct.)
territ.	19.7	869.9	231.4	17.5	0.3	23.6	92.5
ex. territ..	—	44.6	104.3	0.6	2.1	6.6	13.0

As late as November 1940 a large catch could be made on the territory, but, generally, the numbers per catch are small here. Outside the limit a rather considerable number was caught in November 1945, as also in September that year.

The average lengths were as follows:

Year	1938	1939	1945
Summer st.			
territ.	33.6	21.9	32.1
ex. territ.	36.3	31.8	35.9

Territorially, on the whole, the average sizes are somewhat higher than in previous years. Extra-territorially the difference is not pronounced, but most of the samples are too small to give a reliable impression of the conditions.

Spring stations: 1938 and 1939 the territorial average sizes were 18.5 and 32.7, respectively, and in 1945 35.0, while the sizes in 1928 and 1929 were 27.9 and 36.1 respectively. Extra-territorially the 1945 station was the only one to show a somewhat large number with an average size of 25.5 cm. as against 40.1—35.6 in 1927—29.

In 1940 and 1945 the autumn stations showed a territorial average of 44.4 and 39.1 cm, and extra-territorially 30.0 and 42.8, respectively.

C. Halibut.

Summer stations. The average numbers per hour were:

	1938	1939	1945
territ.....	13.8	78.9	13.4
ex. territ.....	4.9	34.3	20.5

While the numbers in 1938 more or less correspond with the numbers from the summer stations of the two previous years taken together, they are somewhat higher than those from the first years

of the researches. However, in 1939 the numbers rise rapidly. The exceptional abundance of young halibut in Faxe Bay may be accounted for by the fact that the year-classes 1937 and 1938 were extraordinarily rich or by the hydrographical conditions ruling in the summer 1939 with an unusually strong influx of Atlantic water, or, possibly, by a combination of both conditions. As late as 1940 (autumn) large catches were made (see Tables 63a—64a).

However, when the researches were resumed in 1945 the stock of young halibut in territorial waters was of the same relatively small size as in 1938.

In 1945 the two summer stations gave the following numbers:

	ca. $\frac{20}{6}$	$\frac{5}{9}$
territ.....	7.1	19.6
ex. territ.....	1.7	38.4

At the September stations the greatest catches were thus made outside the territorial limit. This was also the case in 1931, 1933 and 1934 as well as at a few stations in 1936 and 1937, whilst at all other stations the greatest numbers were caught in territorial waters.

The spring stations showed the following numbers per hour:

	1938	1939	1945	1927	1928	1929
territ.	8.0	23.9	27.3	2.0	1.1	9.4
ex. territ.	12.3	2.1	5.6	1.4	0.9	0.5

Here, also, the research fishery in 1939 shows a relatively large territorial number, and this also applies to the 1945 stations.

With the exception of the results from the experimental trawlings in 1938 the territorial number is the largest.

The autumn stations gave the following results:

Year	1938	1940	1945	1927	1928	1929	1937
territ.	13.1	65.1	16.7	4.0	0.5	7.8	7.2
ex. territ.	14.9	55.0	14.6	3.4	4.1	1.4	6.2

Also during this season the research trawlings show a good increase in the fry of certain year-classes. The 1940 station, like the summer station 1939, shows an unusually large stock.

As to the average size (in cm.) the summer stations show the following:

Year	1938	1939	1945
territ.....	38.5—18.8	23.8—24.4	34.0—34.6
ex. territ.....	34.7—14.5	26.6—18.8	40.4—34.8

As previously the lengths varied much from sample to sample according to whether the 1-year group or older halibut were dominant. The relatively large samples from 1939 show a rather small average size, and the extra-territorial sample from July 1938 also has a very low average size (14.5 cm.). The survey in Tab. 70 gives instances of the variation of the average sizes in different seasons of 1938 and 1945: (see next page)

Table 70.

	1938:	Feb.	March	May	June	July	Sept.	Nov.	Dec.
territ.	35.1	—	—	—	38.5	18.8	—	—	27.4
ex. territ. .	28.4	—	—	—	34.7	14.5	—	—	25.7

	1945:								
territ.	—	27.9	34.0	—	—	34.6	38.3	—	—
ex. territ. .	—	25.4	40.4	—	—	34.8	35.7	—	—

As at some of the stations previously investigated the average size at most of the above stations is greatest within the territorial limit.

D. Cod.

Only a few of the trawling stations have yielded large samples, as shown below:

The summer stations:

	1938		1939		1945	
	23/6	13/7	17/5	28/7	29/5	5/9
territ.	155.2	1.8	14.0	14.9	66.5	12.6
ex. territ.	84.6	15.3	10.8	0.4	90.5	41.5

In spring and autumn the following numbers were taken:

	Feb. (1938)	March (1939)	Nov. (1940)	Dec. (1938)
territ.	8.3	706	422	1.2
ex. territ. ..	7.6	90.7	7.7	0.8

	(1945)
territ.	16.0
ex. territ.	8.5

The average size in the largest samples was as below:

	March (1939)	May (1945)	June (1938)	Nov. (1940)
territ.	52.0	58.2	54.5	77.0
ex. territ. .	67.0	62.0	68.1	28.5

But the material does not give occasion for special comments.

E. Lemon Sole.

The summer stations.

	1938	1939	1945	1936	1937
territ.	40.2	91.1	27.2	102.0	41.9
ex. territ. .	11.0	6.4	5.2	74.0	19.7

On the whole the numbers are considerably higher than in the first years of the researches, and further they vary considerably from sample to sample within the individual years, for instance in 1939 when a sample 17/5 gave $\frac{146}{4.8}$ lemon soles,

while on the 28/7 1939 only $\frac{51.9}{7.5}$ were taken. The stations gave but small catches in the other seasons, greatest in November 1940, i. e., $\frac{44.3}{0.7}$, and December 1938, $\frac{23.4}{0.1}$.

At a large majority of the stations the territorial catches were by far the greatest.

The average size (in cm.) is in most of the samples about 26—30 cm. As instances the following values are given:

	1938:	Feb.	March	May	June	July	Sept.	Nov.	Dec.
territ.	23.4	—	—	—	28.8	25.3	—	—	26.2
ex. territ. .	26.0	—	—	—	28.7	27.3	—	—	28.0

	1945:								
territ.	—	26.3	28.5	—	—	29.6	29.9	—	—
ex. territ. .	—	—	32.6	—	—	32.0	—	—	—

The average size of the samples has thus been somewhat lower in territorial waters than outside the limit. (For further particulars see: Dr. RAE's paper on the stock of Lemon Sole in Faxe Bay [Paper No. 10]).

The great variation within the few and scattered samples from 1938—45 strongly confirms, as previously stated, that only by means of systematically arranged investigations at different seasons and with the greatest possible uniformity of gear and methods, will it be possible to procure a material enabling us to get the necessary knowledge of the movements of the fish stocks and the influence of the fishery upon them.

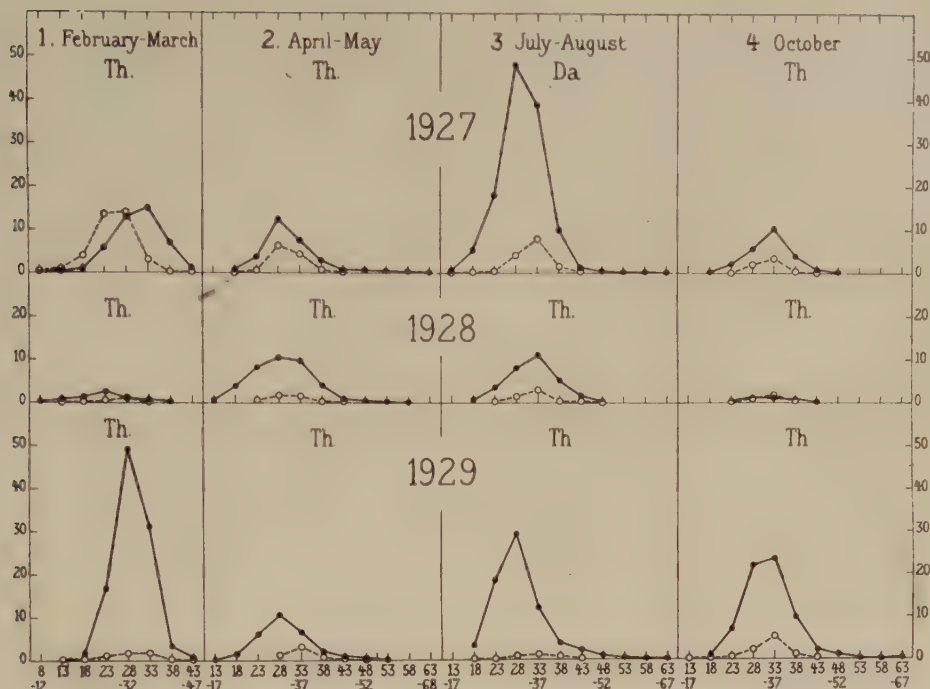


Fig. 28. Plaiice. Quarterly Stations, 1927-1929.

— Territorial Catch - - - - - Extra-territorial Catch

Plaice **Table 56. Number per 1-hour Trawling. Quarterly Stations. 1927-29.****Territorial Station.**

Year:	1927				1928				1929			
Date:	2-4/3	22-23/4	30-7-1/8	15-18/10	22-25/2	4-6/5	5-7/8	11-16/10	17-19/2	7-9/5	18-25/7	8-10/10
Vessel:	Th	Th	Da	Th	Th	Th	Th	Th	Th	Th	Th	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	20	16	30	20	20	20	20	20	20	20	18	20
Total No.	867 ¹	447	3,672 ¹	463	142	768	617	55	2,050	565	1,259	1,321
<23 cm.	1.2	0.6	5.8	0.1	2.3	4.4	0.8	—	1.7	1.4	3.2	0.8
23-27	5.8	3.7	18.1	2.1	2.6	8.3	3.6	0.2	16.7	6.2	18.5	6.9
28-32	13.0	12.5	47.7	5.7	1.2	10.4	8.4	1.05	49.3	10.7	29.7	22.0
33-37	14.9	7.5	38.8	10.5	0.7	9.8	11.0	1.0	30.9	6.7	11.6	23.5
38-42	7.2	2.9	10.0	4.2	0.3	4.3	5.3	0.5	3.3	2.2	3.9	9.5
43-67	1.4	0.7	2.0	0.7	—	1.2	1.9	0.05	0.7	1.1	3.1	3.4
per 1 h.	43.6	27.9	122.4	23.2	7.1	38.4	30.9	2.8	102.5	28.3	70.0	66.1
Av. size ¹	33.0	32.0	31.5	34.0	24.9	32.3	33.6	33.3	31.0	30.9	30.3	33.5
% <23 cm.	2.65	2.24	4.74	0.43	34.51	11.59	2.59	0	1.61	5.13	4.61	1.21

¹ + 4 not measured.**Extra-territorial Station.**

Year:	1927				1928				1929			
Date:	2-4/3	22-23/4	18-27/7	15-18/10	22-25/2	4-6/5	5-7/8	11-16/10	17-19/2	7-9/5	18-25/7	8-10/10
Vessel:	Th	Th	Da	Th	Th	Th	Th	Th	Th	Th	Th	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	20	20	25	20	20	20	20	20	20	20	18	20
Total No.	715	251	355	124	48	87	108	73	102	111	53	199
<23	5.0	0.1	0.1	—	0.3	—	—	—	0.1	—	0.1	0.3
23-27	13.5	0.7	0.4	0.2	0.6	0.6	0.1	0.1	1.1	—	0.1	0.5
28-32	14.0	6.5	4.2	2.2	1.1	1.8	1.6	1.2	1.9	1.4	0.8	2.4
33-37	3.0	4.3	7.8	3.4	0.4	1.7	3.1	1.8	1.9	3.2	1.3	5.4
38-42	0.3	0.8	1.6	0.5	—	0.2	0.5	0.6	0.2	0.8	0.7	1.2
>43	0.1	0.2	0.1	0.1	—	0.2	0.2	—	0.1	0.2	0.1	0.2
per 1 h.	35.8	12.6	14.2	6.2	2.4	4.4	5.4	3.7	5.1	5.6	3.0	10.0
Av. size	27.0	32.4	33.8	33.5	28.2	32.1	34.5	33.8	30.9	35.0	34.3	33.6
% <23 cm.	13.99	0.40	0.56	0	12.5	0	0	0	1.96	0	1.87	3.02

¹ Average sizes not counted by + 0.5 in Tables 56-69.



Fig. 29. Plaiçe. Summer Catches, 1924—1934, "Dana".

— Territorial Catch
 - - - - - Extra-territorial Catch

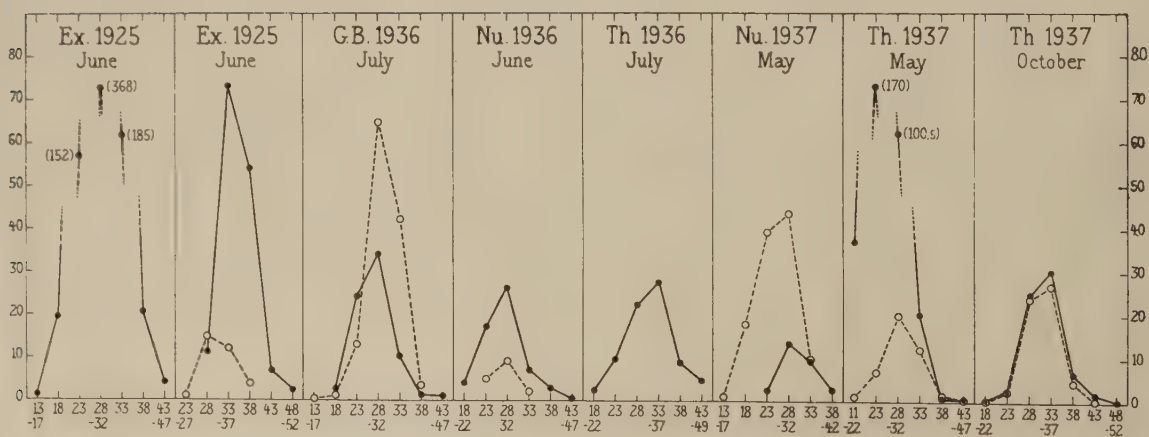


Fig. 30. Plaiçe. Catches in 1925—1937 by "Explorer", "George Bligh", "Nautilus", and "Thor".

— Territorial Catch
 - - - - - Extra-territorial Catch

Place.

Table 57. Number per 1-hour Trawling, 1924—37.

Territorial Station.

Year:	1924	1925	1925	1925	1925	1926	1927	1928	1929	1931
Date:	$25/6, 6/7$	$24/6$	$24/6$	$25/6$	$1-2/8$	$21/6, 1/7$	$20/7, 1/8$	$5/8$	$18-20/7$	$22/7$
Vessel:	Da	Ex33	Ex34 ₁	Ex34 ₂	Da	Da	Da	Th	Th	Da
Gear:	O ₅₀	CT ₁₂₈	CT ₁₂₈	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	32	1	$1/2$	1	20	31	30	20	18	20
Total No.	3,493	147	23	750	3,116	1,272	3,672 ¹	617	1,259	2,602
<23 cm.	2.9			20.0	11.1	0.4	5.8	0.8	3.2	29.6
23—27	17.6		—	152.0	43.1	6.1	18.1	3.6	18.5	26.4
28—32	36.4	$14/6$	4.0	368.0	65.0	20.5	47.7	8.4	29.7	42.4
33—37	35.8	73.0	16.0	185.0	29.2	11.5	38.8	11.0	11.6	21.2
38—42	12.8	54.0	18.0	21.0	6.0	2.2	10.0	5.3	3.9	5.7
>43	3.8	9.0	8.0	4.0	1.3	0.3	2.0	1.9	3.1	4.4
per 1 h.	109.3	147.0	46.0	750.0	155.6	41.0	122.4	30.9	70.0	129.6
Av. size	32.4	36.9	38.4	30.2	29.3	31.3	31.5	33.6	30.3	28.3
% <23 cm.	2.61	0	0	2.67	4.53	1.02	4.74	2.59	4.61	22.75

¹ + 4.

Year:	1932	1933	1934	1936	1936	1936	1937	1937	1937
Date:	$1-5/7$	$18/8$	$11/5$	$2/6$	$5/7$	$18/7$	$24-25/5$	$26/5$	$28/10$
Vessel:	Da	Da	Da	Nu	GB	Th	Th	Nu	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	VD _{39.5}	CT ₁₂₀	VD ₇₅	VD ₇₅	CT _{38.5}	VD ₇₅
Hours:	28	$11 1/2$	8	2	$3 1/2$	$2 1/3$	$7 2/3$	2	13
Total No.	553	568	510	114	255	175	1,589 ¹	56	869
<23 cm.	4.4	21.7	36.8	4.0	2.3	2.6	23.3	—	0.2
23—27	5.8	10.1	20.1	16.5	23.7	9.4	107.0	2.5	2.6
28—32	7.0	11.6	5.5	26.0	34.6	22.3	63.2	13.5	25.1
33—37	2.0	5.2	1.3	7.0	10.3	27.5	12.6	9.0	30.6
38—42	0.2	0.7	—	3.0	1.2	8.6	0.7	2.5	6.7
>43	0.4	0.1	—	0.5	0.8	4.7	0.3	0.5	1.7
per 1 h.	19.8	49.4	63.8	57.0	72.9	75.1	207.2	28.0	66.9
Av. size	27.0	25.0	22.1	29.1	29.2	32.0	26.6	33.1	33.5
% <23 cm.	22.42	44.0	57.8	7.02	3.19	3.43	11.3	0	0.23

¹ of these 931 not measured

Supplementary Table 57 a. February—December, 1938—45.

Territorial

Year:	1938	1938	1938	1938	1939	1939	1939	1940	1945	1945	1945	1945
Date:	$14/2$	$23/6$	$12-13/7$	$14/12$	$29-31/3$	$17-18/5$	$27-29/7$	$1-4/11$	$28/2-1/3$	$28-30/5$	$5/9$	$16-17/11$
Vessel:	Th	Th	Da	Th	Th	Th	Da	R	Sk	Br	Br	Br
Gear:	CT ₇₅	CT ₇₅	O ₅₀	CT ₇₅	CT ₇₅	CT ₇₅	O ₅₀	CT ₉₀	CT ₆₅	CT ₆₅	CT ₆₅	CT ₆₅
Hours:	10	4	10	10	10	5	7	$3 1/2$	10	10	10	10
Total No.	1,592	363	445	2,155	2,671	1,263	492	64	2,161	590	425 ¹	199
<23 cm.	31.6	20.0	19.1	3.8	81.3	78.4	15.9	—	21.1	7.0	6.0	0.3
23—27	40.3	37.8	16.2	32.6	129.8	115.6	34.6	0.9	72.3	12.1	8.6	1.9
28—32	62.7	17.5	6.5	106.4	45.2	42.2	14.0	4.3	92.8	19.0	14.2	5.7
33—37	22.6	13.3	2.5	64.0	8.8	14.8	5.3	9.1	27.3	14.1	8.9	9.2
38—42	1.7	2.0	0.1	7.7	1.7	1.4	0.4	3.4	2.3	4.1	3.5	2.4
>43	0.3	0.3	—	1.0	0.3	0.2	0.1	0.6	0.3	2.7	1.3	0.4
per 1 hour	159.2	90.8	44.5	215.5	267.1	252.6	70.3	18.3	216.1	59.0	42.5	19.9
Av. size	27.4	26.5	24.1	31.0	24.7	24.9	25.7	34.6	28.0	30.4	30.2	33.2
% <23 cm.	19.8	22.0	43.0	1.8	30.4	31.0	22.6	0.0	9.8	12.0	14.2	1.5

¹ of these 86 not measured.

Plaice.

Table 58. Number per 1-hour Trawling. 1924—37.

Extra-territorial Station.

Year:	1924	1925	1925	1926	1927	1928	1929	1931
Date:	¹¹ / ₆ , ²¹ / ₆	²⁴ / ₆	³⁰ / ₇ , ⁷ / ₈	²⁵ / ₆ , ²⁷ / ₆	¹⁸ / ₇	⁵ / ₈	¹³ / ₇	²⁷ / ₇
Vessel:	Da	Ex32	Da	Da	Da	Th	Th	Da
Gear:	O ₅₀	CT ₁₂₈	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	51	1	19	26	25	20	18	20
Total No.	743	32	81	63	355	108	53	212
<23 cm.	0.3	—	0.1	—	0.1	—	0.1	0.1
23—27	1.1	1.0	0.3	0.04	0.4	0.1	0.1	0.6
28—32	4.5	15.0	1.3	0.9	4.2	1.6	0.8	4.1
33—37	5.5	12.0	2.0	1.2	7.8	3.1	1.3	5.4
38—42	2.5	4.0	0.5	0.2	1.6	0.6	0.7	0.5
>43	0.7	—	0.1	—	0.1	—	0.1	0.1
per 1 h.	14.6	32.0	4.3	2.4	14.2	5.4	3.0	10.6
Av. size	33.9	32.8	33.5	33.3	33.8	34.5	34.3	32.8
% <23 cm.	2.15	0	1.23	0	0.56	0	1.9	0.47
Year:	1932	1933	1934	1936	1936	1937	1937	1937
Date:	³ / ₇	²¹ / ₈	¹⁴ / ₅	² / ₆	⁶ / ₇	²³ / ₅ , ²⁴ / ₅	²⁵ / ₅	²⁷ / ₁₀
Vessel:	Da	Da	Da	Nu	GB	Th	Nu	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	VD _{38.5}	CT ₁₂₀	VD ₇₅	CT _{38.5}	VD ₇₅
Hours:	28	11	5	2	4	10	2	14 ¹ / ₂
Total No.	432	452	85	33	495	419	220	843
<23	0.5	2.6	1.4	—	1.3	1.1	18.5	0.1
23—27	3.3	14.4	5.4	5.0	13.0	9.7	39.0	2.4
28—32	8.7	20.5	6.0	9.5	64.5	25.5	43.5	30.7
33—37	2.6	3.6	4.2	2.0	41.8	4.5	9.0	20.0
38—42	0.2	—	—	—	3.3	0.8	—	4.7
>43	0.04	—	—	—	—	0.3	—	0.2
per 1 h.	15.4	41.1	17.0	16.5	123.8	41.9	110.0	58.1
Av. size	29.6	28.0	28.8	29.2	31.4	29.5	26.97	33.0
% <23 cm.	3.24	6.42	8.24	0	1.01	2.6	16.82	0.24

Supplementary Table 58 a. February—December, 1938—45.

Extra-territorial

Year:	1938	1938	1938	1938	1939	1939	1939	1940	1945	1945	1945	1945
Date:	¹³ / ₁₄ , ²² / ₆	²² / ₆	¹¹ / ₁₂ , ¹² / ₇	¹³ / ₁₂	²⁸ / ₃	¹⁶ / ₁₇ , ¹⁷ / ₅	²⁷ / ₂₉ , ²⁹ / ₇	² / ₁₁	²⁸ / ₈ , ¹ / ₃	²⁹ / ₅	⁵ / ₆ , ⁶ / ₉	¹⁷ / ₁₁
Vessel:	Th	Th	Da	Th	Th	Th	Da	R	Sk	Br	Br	Br
Gear:	CT ₇₅	CT ₇₅	O ₅₀	CT ₇₅	CT ₇₅	CT ₇₅	O ₅₀	CT ₉₀	CT ₆₅	CT ₆₅	CT ₆₅	CT ₆₅
Hours:	10	8	10	10	10	5	7	3	10	10	10	10
Total No.	832	172	59	1,437	2,185	225	80	152	287	38	487	517
<23 cm.	9.9	1.0	—	2.6	3.3	4.0	—	—	4.6	0.1	0.7	0.2
23—27	34.8	3.4	0.4	40.3	38.0	11.8	2.0	1.3	12.9	0.4	5.1	1.7
28—32	33.7	8.0	1.8	86.1	120.3	20.2	4.9	15.3	9.4	0.7	18.0	13.2
33—37	4.4	7.4	2.9	14.5	51.2	8.8	3.6	24.7	1.4	1.5	20.3	25.9
38—42	0.4	1.4	0.8	0.2	5.3	0.2	1.0	8.3	0.3	0.6	4.3	9.6
>43	—	0.4	—	—	0.4	—	—	1.0	0.1	0.5	0.3	1.1
per 1 hour	83.2	21.5	5.9	143.7	218.5	45.0	11.4	50.7	28.7	3.8	48.7	51.7
Av. size	27.0	31.2	33.3	29.0	30.4	28.7	32.0	34.2	26.5	35.5	32.4	34.5
% <23 cm.	11.9	4.7	0.0	1.8	1.5	8.9	0.0	0.0	16.0	2.6	1.4	0.4

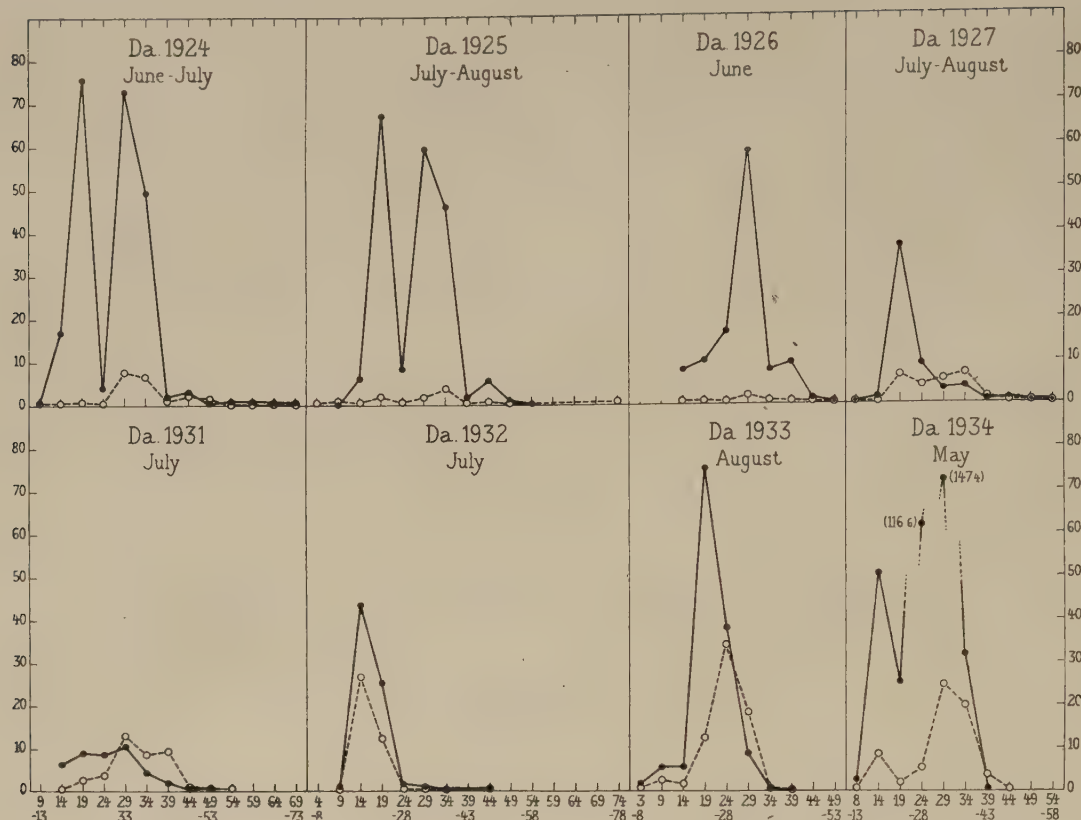


Fig. 32. Haddock. Summer Catches, 1924—1934, "Dana".
 ————— Territorial Catch - - - - - Extra-territorial Catch

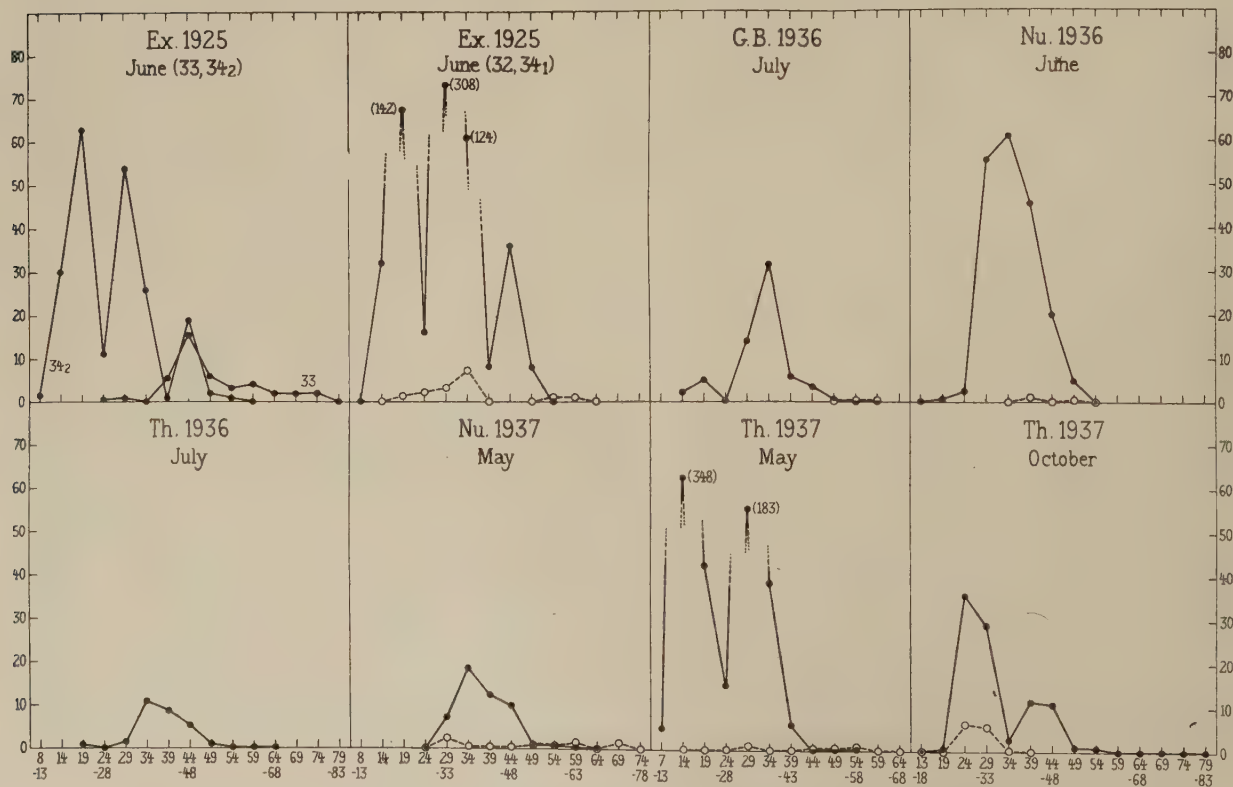


Fig. 33. Haddock. Catches in 1925—1937 by "Explorer", "George Bligh", "Nautilus", and "Thor".
 "Explorer" St. 34₁ on the territorial limit, St. 33 and 34₂ inside the territorial limit.

Haddock.

Table 60. Number per 1-hour Trawling, 1924—37.

Territorial Station.

Year:	1924	1925	1925	1925	1925	1926	1927	1928	1929	1931
Date:	²⁵ / ₆ , ⁶ / ₇	²⁴ / ₆	²⁴ / ₆	²⁵ / ₆	¹ / ₃	²¹ / ₆ , ¹ / ₇	¹ / ₈	⁵ / ₈	¹⁸ / ₇	²² / ₇
Vessel:	Da	Ex33	Ex34 ₁	Ex34 ₂	Da	Da	Da	Th	Th	Da
Gear:	O ₅₀	CT ₁₂₈	CT ₁₂₈	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	32	1	¹ / ₂	1	20	31	24	20	18	20
Total No.	7,171	42	337	208	3,905	3,504	1,338	224	536	804
<24 cm.	92.4	—	174.0	93.0	73.3	18.1	37.4	0.7	24.8	15.25
24—28	4.0	—	16.0	11.0	8.3	17.3	9.2	0.7	4.3	8.3
29—33	72.7	1.0	308.0	54.0	59.1	58.9	3.3	2.0	0.2	10.4
34—38	49.4	—	124.0	26.0	46.0	7.9	3.8	7.5	0.2	4.1
39—43	1.8	5.0	8.0	1.0	1.9	9.5	0.9	0.2	0.2	2.05
>44	3.8	36.0	44.0	23.0	6.8	1.2	1.2	0.15	0.06	0.2
per 1 h.	224.1	42.0	674.0	208.0	195.3	113.0	55.8	11.2	29.7	40.3
Av. size	27.1	53.5	30.4	28.2	28.7	29.6	24.3	33.7	22.3	26.4
% <24 cm.	41.24	0	25.82	44.71	37.52	15.98	67.04	6.25	83.21	37.93
Year:	1932	1933	1934	1936	1936	1936	1937	1937	1937	
Date:	¹ / ₇	¹⁸ / ₈	¹¹ / ₅	² / ₆	⁵ / ₇	¹⁸ / ₇	²⁴ / _— ²⁵ / ₅	²⁵ / ₅	²⁸ / ₁₀	
Vessel:	Da	Da	Da	Nu	GB	Th	Th	Nu	Th	
Gear:	O ₅₀	O ₅₀	O ₅₀	VD _{38.5}	CT ₁₂₀	VD ₇₅	VD ₇₅	CT _{38.5}	VD ₇₅	
Hours:	28	¹¹ / ₂	8	2	³ / ₂	² / ₃	⁷ / ₃	2	13	
Total No.	2,025	1,554	2,994	380	220	66	4,477 ¹	101	1,202	
<24	68.7	87.9	77.9	0.5	7.2	0.9	361.3	—	0.7	
24—28	2.0	37.9	116.6	2.5	0.3	—	13.7	—	35.8	
29—33	1.3	8.9	147.4	55.5	13.7	1.3	167.1	7.0	28.8	
34—38	0.3	0.3	32.0	61.0	31.4	10.7	35.2	18.5	2.5	
39—43	—	0.01	0.4	45.5	5.7	8.6	5.5	12.5	11.5	
>44	0.04	—	—	25.0	4.6	6.9	0.9	12.5	13.0	
per 1 h.	72.3	135.1	374.3	190.0	62.9	28.3	583.7	50.5	92.5	
Av. size	18.6	22.0	27.1	36.9	34.2	40.0	22.5	39.6	32.8	
% <24 cm.	94.96	65.06	20.81	0.26	11.36	3.03	61.9	0	0.75	

¹ of these 3,199 not measured

Supplementary Table 60 a. February—December, 1938—45.

Territorial

Year:	1938	1938	1938	1938	1939	1939	1939	1940	1945	1945	1945	1945
Date:	¹⁴ / ₂	²³ / ₆	¹² / _— ¹³ / ₇	¹⁴ / ₁₂	²⁹ / _— ³¹ / ₃	¹⁷ / _— ¹⁸ / ₅	²⁷ / _— ²⁹ / ₇	¹ / _— ⁴ / ₁₁	²⁸ / ₃ [—] ¹ / ₃	²⁸ / _— ³⁰ / ₅	⁵ / ₉	¹⁶ / _— ¹⁷ / ₁₁
Vessel:	Th	Th	Da	Th	Th	Th	Da	R	Sk	Br	Br	Br
Gear:	CT ₇₅	CT ₇₅	O ₅₀	CT ₇₅	CT ₇₅	CT ₇₅	O ₅₀	CT ₉₀	CT ₆₅	CT ₆₅	CT ₆₅	CT ₆₅
Hours:	10	4	10	10	10	5	7	³ / ₂	10	10	10	10
Total No.	344	1,302	415	197	3,643	2,829	270	3,045 ¹	17	2,822	4,100 ²	2,314
<24 cm.	25.7	18.0	31.1	0.2	3.2	4.4	1.0	1.1	—	2.1	34.0	3.4
24—28	7.7	9.3	2.1	12.1	133.4	124.4	1.0	113.4	0.2	35.2	52.3	48.8
29—33	0.8	145.0	8.1	4.1	58.6	259.0	19.9	125.4	0.6	64.2	55.1	16.6
34—38	0.0	127.3	0.2	2.6	100.7	89.4	12.6	18.0	0.5	125.9	86.8	33.2
39—43	0.1	8.8	—	0.6	54.1	83.8	2.1	65.7	0.1	44.8	106.1	42.1
>44	0.1	17.3	—	0.1	14.3	4.8	2.0	546.3	0.3	10.0	75.7	87.3
per 1 hour	34.4	325.5	41.5	19.7	364.3	565.8	38.6	870.0	1.7	282.2	410.0	231.4
Av. size	18.5	33.6	21.9	28.9	32.7	32.1	33.8	44.4	35.0	35.1	36.8	39.1
% <24 cm.	74.7	5.5	75.0	1.0	0.9	0.8	2.6	0.1	0.0	0.7	8.3	1.5

¹ of these 1602 not measured. ² of these 1445 not measured.

Haddock.

Table 61. Number per 1-hour Trawling. 1924—37.

Extra-territorial Station.

Year:	1924	1925	1925	1926	1927	1928	1929	1931
Date:	11—21/6	24/6	30/7, 7/8	25/7—6/8	18—27/7	5/8	18—26/7	27/7
Vessel:	Da	Ex32	Da	Da	Da	Th	Th	Da
Gear:	O ₅₀	CT ₁₂₈	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours	51	1	19	20	25	20	18	20
Total No.	1,080	15	189	82	655	58	10	751
<24 cm.	1.8	1.0	3.1	0.45	6.8	0.15	0.15	2.95
24—28	0.3	2.0	0.6	0.75	4.04	0.05	0.15	3.7
29—33	7.9	3.0	1.7	2.25	5.8	0.15	0.1	12.9
34—38	6.7	7.0	3.8	0.2	7.16	1.55	0.1	8.15
39—43	1.0	—	0.2	0.35	1.4	0.35	0.1	9.1
>44	3.5	2.0	0.6	0.1	1.0	0.65	—	0.75
per 1 h.	21.1	15.0	9.95	4.1	26.2	2.9	0.6	37.6
Av. size	34.98	35.5	26.8	30.2	30.2	37.2	27.3	33.3
% <24 cm.	8.33	6.67	24.87	10.98	26.11	0	30.0	7.86

Year:	1932	1933	1934	1936	1936	1937	1937	1937
Date:	3—6/7	21/8	14/5	2/6	6/7	23—24/5	25/5	27/10
Vessel:	Da	Da	Da	Nu	GB	Th	Nu	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	VD _{38.5}	CT ₁₂₀	VD ₇₅	CT _{38.5}	VD ₇₅
Hours:	28	11	4	2	4	10	2	14 1/2
Total No.	1,121	769	263	3	4	43	18	189
<24	39.0	17.1	11.5	—	—	0.3	—	0.4
24—28	0.3	34.2	5.25	—	—	0.1	—	6.3
29—33	0.6	18.4	24.75	—	—	1.1	2.5	5.9
34—38	0.07	0.2	20.0	—	—	0.6	0.5	0.3
39—43	—	—	4.0	1.0	—	0.2	0.5	0.1
>44	0.04	—	0.25	0.5	1.0	2.0	5.5	—
per 1 h.	40.0	69.9	65.8	1.5	1.0	4.3	9.0	13.0
Av. size	18.0	25.5	30.3	43.0	57.0	42.9	49.4	28.57
% <24 cm.	97.5	24.45	17.45	0	0	6.98	0	3.17

Supplementary Table 61 a. February—November,¹ 1938—45.

Extra-territorial

Year:	1938	1938	1938	1939	1939	1939	1940	1945	1945	1945	1945
Date:	13—14/2	22/6	11—12/7	28—29/3	16—17/5	27—29/7	2—3/11	28/2—1/3	29/5	5—6/9	17/11
Vessel:	Th	Th	Da	Th	Th	Da	R	Sk	Br	Br	Br
Gear:	CT ₇₅	CT ₇₅	O ₅₀	CT ₇₅	CT ₇₅	O ₅₀	CT ₉₀	CT ₆₅	CT ₆₅	CT ₆₅	CT ₆₅
Hours:	10	8	10	10	5	7	3	10	10	10	10
Total No.	7	374	121	10	9	64	134	19	189	3598	1,043
<24 cm.	0.7	1.0	1.1	—	—	0.4	0.3	0.4	—	32.3	0.4
24—28	—	0.9	0.5	0.1	—	—	18.0	0.4	—	31.5	19.1
29—33	—	15.3	6.1	0.1	1.0	4.6	21.3	0.9	0.1	55.4	9.3
34—38	—	19.8	4.2	0.3	—	2.6	1.7	0.2	0.8	70.5	14.3
39—43	—	3.0	0.2	0.5	0.4	1.1	2.3	—	5.0	96.8	20.6
>44	—	6.9	—	—	0.4	0.4	1.0	—	13.0	73.3	40.6
per 1 hour	0.7	46.8	12.1	1.0	1.8	9.1	44.7	1.9	18.9	359.8	104.3
Av. size	15.9	36.3	31.8	36.4	35.9	34.0	30.0	25.5	51.2	36.9	42.8
% <24 cm.	100.0	2.1	9.1	0.0	0.0	4.7	0.7	21.1	0.0	9.0	0.4

¹ No haddock were caught in December 1938.

Halibut.

Table 62. Number per 1-hour Trawling. Quarterly Stations. 1927—29.

Territorial Station.

Year:	1927				1928				1929			
Date:	2/3	22/4	20/7, 1/8	15/10	22/2	4/5	5/8	11/10	17/2	7/5	18/7	8/10
Vessel:	Th	Th	Da	Th	Th	Th	Th	Th	Th	Th	Th	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	20	16	24	20	20	20	20	20	20	20	18	20
Total No.	39 ¹	29	303	79	22	112	86	10	188	149	115	156
<23 cm.	0	0.06	1.6	1.3	0.65	1.0	0.1	0.1	0.55	—	1.11	1.6
23—27	0.3	0.25	1.3	0.25	0.25	2.8	1.65	—	1.8	0.65	0.4	1.8
28—32	0.55	0.5	2.3	0.3	0.05	0.55	1.6	0.25	3.6	1.0	1.7	0.65
33—37	0.35	0.75	1.2	0.8	0.15	0.45	0.35	0.15	2.55	3.1	1.4	1.35
38—42	0.05	0.2	1.8	1.0	—	0.45	0.15	—	0.7	1.7	0.9	0.9
>43	—	0.06	1.9	0.3	—	0.35	0.5	—	0.2	1.0	0.9	1.5
per 1 h.	1.95	1.8	10.1	3.95	1.1	5.6	4.3	0.5	9.4	7.45	6.4	7.8
Av. size	30.9	32.5	32.9	30.9	23.1	27.7	30.5	29.5	31.9	36.2	32.5	32.4

¹ 25 measured, 14 not measured.

Extra-territorial Station.

Year:	1927				1928				1929			
Date:	2/3	22/4	18/7	15/10	22/2	4/5	5/8	11/10	17/2	7/5	25/7	10/10
Vessel:	Th	Th	Da	Th	Th	Th	Th	Th	Th	Th	Th	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	20	20	25	20	20	20	20	20	20	20	18	20
Total No.	27	21	234	68	18	18	94	81	9	44	29	27
<23	0.95	0.1	2.0	1.4	0.4	0.2	0.1	—	—	—	0.2	0.3
23—27	0.15	0.2	1.1	0.25	0.25	0.3	0.9	0.3	—	—	—	0.25
28—32	0.25	0.2	1.4	0.35	0.2	0.3	2.4	1.95	0.35	0.9	0.1	0.15
33—37	—	0.35	2.2	0.75	0.05	—	1.0	1.2	0.05	0.85	0.6	0.2
38—42	—	0.1	1.4	0.2	—	0.1	0.2	0.45	—	0.4	0.6	0.3
>43	—	0.1	1.2	0.45	—	—	0.1	0.15	0.05	0.05	0.1	0.15
per 1 h.	1.35	1.05	9.4	3.4	0.9	0.9	4.7	4.05	0.45	2.2	1.6	1.35
Av. size	14.7	32.3	30.8	29.3	24.3	27.3	30.5	33.0	32.6	34.4	34.7	31.7

Halibut.

Table 63. Number per 1-hour Trawling. 1924—37.

Territorial Station.

Year:	1924	1925	1925	1925	1925	1926	1927	1928	1929	1931
Date:	$\frac{25}{6}, \frac{6}{7}$	$\frac{24}{6}$	$\frac{24}{6}$	$\frac{25}{6}$	$\frac{1}{8}$	$\frac{21}{6}, \frac{1}{7}$	$\frac{20}{7}, \frac{1}{8}$	$\frac{5}{8}$	$\frac{18}{7}$	$\frac{22}{7}$
Vessel:	Da	Ex33	Ex34 ₁	Ex34 ₂	Da	Da	Da	Th	Th	Da
Gear:	O ₅₀	CT ₁₂₈	CT ₁₂₈	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	32	1	$\frac{1}{2}$	1	20	31	30	20	18	20
Total No.	697	18	17	94	73	140	303	86	115	115
<23 cm.	3.6	—	4.0	2.0	0.15	0.8	1.6	0.1	1.1	3.25
23—27	7.5	—	12.0	37.0	0.15	2.1	1.3	1.65	0.4	1.1
28—32	2.25	—	6.0	34.0	0.65	0.1	2.3	1.6	1.7	0.05
33—37	4.2	7.0	8.0	10.0	0.8	0.5	1.2	0.35	1.4	0.5
38—42	3.1	8.0	4.0	9.0	1.3	0.4	1.8	0.15	0.9	0.7
>43	1.15	3.0	—	2.0	0.6	0.6	1.9	0.5	0.9	0.15
per 1 h.	21.8	18.0	34.0	94.0	3.65	4.5	10.1	4.3	6.4	5.75
Av. size	29.9	39.8	29.2	29.6	36.6	30.1	32.9	30.5	32.5	24.0

Year:	1932	1933	1934	1936	1936	1936	1937	1937	1937
Date:	$\frac{1}{7}$	$\frac{18}{8}$	$\frac{11}{5}$	$\frac{2}{6}$	$\frac{5}{7}$	$\frac{18}{7}$	$\frac{24}{5}, \frac{25}{5}$	$\frac{26}{5}$	$\frac{28}{10}$
Vessel:	Da	Da	Da	Nu	GB	Th	Th	Nu	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	VD _{38.5}	CT ₁₂₀	VD ₇₅	VD ₇₅	CT _{38.5}	VD ₇₅
Hours:	28	11 $\frac{1}{2}$	8	2	3 $\frac{1}{2}$	2 $\frac{1}{3}$	7 $\frac{2}{3}$	2	13
Total No.	164	36	20	29	53	69	231	18	93
<23	1.9	0.3	0.1	—	2.3	0.9	0.5	—	0.1
23—27	1.6	1.4	0.9	1.5	0.3	—	17.3	1.0	2.1
28—32	1.04	0.6	0.75	10.0	1.1	3.0	11.0	3.5	0.3
33—37	1.0	0.4	0.5	2.0	4.0	14.6	0.9	4.0	2.1
38—42	0.3	0.2	0.25	0.5	2.3	6.4	0.4	—	1.9
>43	0.1	0.3	—	0.5	5.15	4.7	—	0.5	0.7
per 1 h.	5.9	3.1	2.5	14.5	15.15	29.6	30.1	9.0	7.2
Av. size	26.8	29.5	30.0	31.0	36.3	36.9	27.45	32.7	34.3

Supplementary Table 63 a. February—December, 1938—45.

Territorial

Year:	1938	1938	1938	1938	1939	1939	1939	1940	1945	1945	1945	1945
Date:	$\frac{14}{2}$	$\frac{23}{6}$	$\frac{12}{13}, \frac{13}{7}$	$\frac{14}{12}$	$\frac{29}{31}, \frac{31}{3}$	$\frac{17}{18}, \frac{18}{5}$	$\frac{27}{29}, \frac{29}{7}$	$\frac{1}{4}, \frac{4}{11}$	$\frac{28}{2}, \frac{1}{3}$	$\frac{28}{30}, \frac{30}{5}$	$\frac{5}{9}$	$\frac{16}{17}, \frac{17}{11}$
Vessel:	Th	Th	Da	Th	Th	Th	Da	R	Sk	Br	Br	Br
Gear:	CT ₇₅	CT ₇₅	O ₅₀	CT ₇₅	CT ₇₅	CT ₇₅	O ₅₀	CT ₈₀	CT ₆₅	CT ₆₅	CT ₆₅	CT ₆₅
Hours:	10	4	10	10	10	5	7	3 $\frac{1}{2}$	10	10	10	10
Total No.	80	102	91	131	239	578	369	228	273	71	196	167
<23 cm.	0.2	0.3	7.5	2.6	4.2	34.6	23.1	14.9	2.3	0.1	1.7	0.2
23—27	0.8	0.5	0.2	5.7	10.2	66.0	8.1	10.3	15.0	1.6	0.4	2.2
28—32	1.0	5.2	0.5	2.5	5.4	11.0	14.6	2.3	5.3	2.6	5.3	0.7
33—37	2.9	8.0	0.3	1.3	1.5	2.0	6.6	6.6	1.6	0.8	7.6	3.9
38—42	3.0	3.5	0.3	0.6	1.3	1.4	0.1	10.0	2.6	0.8	2.8	5.2
>43	0.1	8.0	0.3	0.4	1.3	0.6	0.1	21.1	0.5	1.2	1.8	4.5
per 1 hour	8.0	25.5	9.1	13.1	23.9	115.6	52.7	65.1	27.3	7.1	19.6	16.7
Av. size	35.1	38.5	18.8	27.4	27.9	23.8	24.4	34.7	27.9	34.0	34.6	38.3

Halibut.

Table 64. Number per 1-hour Trawling. 1924—37.

Extra-territorial Station.

Year:	1924	1925	1925	1926	1927	1928	1929	1931
Date:	11—25/6	24/6	30/7, 7/8	25/6	18/7	5/8	12/7	27/7
Vessel:	Da	Ex32	Da	Da	Da	Th	Th	Da
Gear:	O ₅₀	CT ₁₂₈	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	51	1	18	26	25	20	18	20
Total No.	494	11	74	38	234	94	29	231
<23 cm.	2.8	—	1.0	0.5	2.0	0.1	0.2	2.3
23—27	4.2	1.0	0.2	0.7	1.1	0.9	—	3.4
28—32	1.0	5.0	0.6	0.15	1.4	2.4	0.1	1.9
33—37	0.8	5.0	1.3	0.04	2.2	1.0	0.6	1.8
38—42	0.7	—	0.4	0.1	1.4	0.2	0.6	1.35
>43	0.3	—	0.5	—	1.2	0.1	0.1	0.85
per 1 h.	9.7	11.0	4.1	1.5	9.4	4.7	1.6	11.6
Av. size	26.3	32.36	29.8	25.0	30.8	30.5	34.7	29.5
Year:	1932	1933	1934	1936	1936	1937	1937	1937
Date:	3/7	21/8	14/5	2/6	6/7	23—24/5	25/5	27/10
Vessel:	Da	Da	Da	Nu	GB	Th	Nu	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	VD _{38.5}	CT ₁₂₀	VD ₇₅	CT _{38.5}	VD ₇₅
Hours:	28	11	4	2	4	10	2	14 1/2
Total No.	96	85	28	1	231	33	39	90
<23	1.4	2.3	1.25	—	22.78	0.1	1.0	0.1
23—27	1.5	3.55	3.25	—	3.25	1.0	6.0	0.7
28—32	0.3	0.7	2.0	0.5	17.25	1.3	10.0	0.3
33—37	0.14	0.4	0.5	—	13.25	0.3	2.5	1.9
38—42	0.04	0.3	—	—	1.0	0.3	—	2.2
>43	0.07	0.5	—	—	0.25	0.3	—	1.0
per 1 h.	3.43	7.7	7.0	0.5	57.75	3.3	19.5	6.2
Av. size	26.2	27.0	26.8	(30.0)	25.5	30.91	27.97	37.4

Supplementary Table 64 a. February—December 1938—45.

Extra-territorial

Year:	1938	1938	1938	1938	1939	1939	1939	1940	1945	1945	1945	1945
Date:	13—14/2	22/6	11—12/7	13/12	28—29/3	16/5	27—29/7	2—3/11	28/2—1/3	29/5	5—6/9	17/11
Vessel:	Th	Th	Da	Th	Th	Th	Da	R	Sk	Br	Br	Br
Gear:	CT ₇₅	CT ₇₅	O ₅₀	CT ₇₅	CT ₇₅	CT ₇₅	O ₅₀	CT ₉₀	CT ₆₅	CT ₆₅	CT ₆₅	CT ₆₅
Hours:	10	8	10	10	10	5	7	3	10	10	10	10
Total No.	123	23	66	149	21	140	271	165	56	17	384	146
<23 cm.	2.4	—	6.5	1.8	—	3.2	30.0	10.7	0.5	—	3.1	0.1
23—27	4.8	0.3	—	9.9	0.7	13.4	2.0	19.3	4.3	—	0.6	2.4
28—32	4.0	1.0	—	3.1	1.0	10.2	5.6	8.3	0.7	0.5	8.3	1.4
33—37	0.9	0.6	0.1	—	0.3	0.6	0.9	4.0	—	—	16.1	4.7
38—42	0.2	0.8	—	0.1	0.1	0.2	0.3	9.7	0.1	0.3	7.5	4.1
>43	—	0.3	—	—	—	0.4	—	3.0	—	0.9	2.8	1.9
per 1 hour	12.3	2.9	6.6	14.9	2.1	28.0	38.7	55.0	5.6	1.7	38.4	14.6
Av. size	28.4	34.7	14.5	25.7	29.1	26.6	18.8	29.1	25.4	40.4	34.8	35.7

Cod **Table 65. Number per 1-hour Trawling. Quarterly Stations. 1927—29.**

Territorial Station.

Year:	1927				1928				1929			
Date:	$\frac{2}{3}$	$\frac{22}{4}$	$\frac{20}{7}, \frac{1}{8}$	$\frac{15}{10}$	$\frac{22}{2}$	$\frac{4}{5}$	$\frac{5}{8}$	$\frac{11}{10}$	$\frac{17}{2}$	$\frac{7}{5}$	$\frac{18}{7}$	$\frac{8}{10}$
Vessel:	Th	Th	Da	Th	Th	Th	Th	Th	Th	Th	Th	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	20	16	27	20	20	20	20	20	20	20	18	20
Total No.	102	141	35	32	27	9	1	4	10	20	1	62
<24 cm.	0.15	0.1	0.8	0.1	—	—	—	0.15	—	—	0.06	0.5
24—43	0.65	0.3	0.3	0.95	0.5	0.1	0.05	0.05	0.35	0.6	—	2.4
44—63	0.15	1.3	0.1	0.1	0.2	0.2	—	—	0.15	0.05	—	0.05
64—93	3.45	4.7	0.1	0.5	0.45	0.15	—	—	—	0.2	—	0.25
>94	0.70	2.5	—	—	0.2	—	—	—	—	0.15	—	—
per 1 h.	5.1	8.8	1.3	1.6	1.4	0.5	0.05	0.2	0.5	1.0	0.06	3.1
Av. size	74.6	77.8	26.5	46.5	44.9	57.9	(26.0)	19.0	39.3	52.8	(20.0)	33.7
% <24 cm.	2.9	1.4	60.0	6.25	0	0	0	75.0	0	0	100.0	14.5

Extra-territorial Station.

Year:	1927				1928				1929			
Date:	$\frac{2}{3}$	$\frac{22}{4}$	$\frac{10}{27}, \frac{1}{7}$	$\frac{15}{10}$	$\frac{22}{2}$	$\frac{4}{5}$	$\frac{5}{8}$	$\frac{11}{10}$	$\frac{17}{2}$	$\frac{7}{5}$	$\frac{18}{7}$	$\frac{8}{10}$
Vessel:	Th	Th	Da	Th	Th	Th	Th	Th	Th	Th	Th	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	20	20	25	20	20	20	20	20	20	20	18	20
Total No.	3	176	173	111	21	2	6	6	55	20	31	48
<24	0.1	—	2.9	0.15	0.2	—	0.05	0.1	—	—	0.1	0.45
24—43	—	0.45	3.2	4.9	0.8	—	0.25	0.2	—	0.8	1.55	1.45
44—63	—	5.35	0.6	0.2	—	0.1	—	—	0.85	—	0.05	0.3
64—93	0.05	2.75	0.2	0.3	0.05	—	—	—	1.7	0.2	—	0.1
>94	—	0.25	—	—	—	—	—	—	0.2	—	—	0.1
per 1 h.	0.15	8.8	6.9	5.5	1.1	0.1	0.3	0.3	2.8	1.0	1.7	2.4
Av. size	35.7	61.6	28.4	34.2	28.9	(52.5)	29.5	24.2	70.7	46.1	31.5	34.3
% <24 cm.	66.67	0	42.20	2.70	19.05	0	16.67	33.3	0	0	6.45	18.75

Cod. Table 66. Number per 1-hour Trawling. 1924—37.

Territorial Station.

Year:	1924	1925	1925	1925	1925	1926	1927	1928	1929	1931
Date:	$25/6, 6/7$	$24/6$	$24/6$	$25/6$	$1/8$	$21/6, 1/7$	$20/7, 1/8$	$5/8$	$18-25/7$	$22/7$
Vessel:	Da	Ex33	Ex34 ₁	Ex34 ₂	Da	Da	Da	Th	Th	Da
Gear:	O ₅₀	CT ₁₃₈	CT ₁₃₈	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	32	1	$1\frac{1}{2}$	1	20	31	27	20	18	20
Total No.	1,197	691	10	10	205	65	35	1	1	9
<24 cm.	0.03	—	—	—	5.0	0.74	0.8	—	0.06	0.3
24—43	30.9	371.0	—	10.0	4.25	1.3	0.3	0.05	—	0.15
44—63	5.78	290.0 ⁷⁹	6.0	—	0.7	0.03	0.1	—	—	—
64—93	0.7	30.0	14.0	—	0.3	—	0.1	—	—	—
>94	0.03	—	—	—	0.05	—	—	—	—	—
per 1 h.	37.4	691.0	20.0	10.0	10.3	2.1	1.3	0.05	0.06	0.45
Av. size	39.1	47.07	73.9	34.6	27.8	26.7	26.5	(26.0)	(20.0)	30.4
% <24 cm.	0.08	0	0	0	48.29	36.51	60.0	0	100	66.67

Year:	1932	1933	1934	1936	1936	1936	1937	1937	1937
Date:	$1-5/7$	$18/8$	$11/5$	$2/6$	$5/7$	$18/7$	$24-25/5$	$26/5$	$28/10$
Vessel:	Da	Da	Da	Nu	GB	Th	Th	Nu	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	VD ₃₈₋₅	CT ₁₂₀	VD ₇₅	VD ₇₅	CT ₃₈₋₅	VD ₇₅
Hours:	8	$11\frac{1}{2}$	8	2	$3\frac{1}{2}$	$2\frac{1}{3}$	$7\frac{2}{3}$	2	13
Total No.	9	2	26	6	331	261	18	672	362
<24	0.8	0.2	0.9	—	26.6	—	0.8	—	0.2
24—43	0.4	—	0.25	—	12.6	24.5	1.6	141.0	5.5
44—63	—	—	1.5	1.0	24.6	76.4	—	141.0	2.8
64—93	—	—	0.6	1.0	30.0	10.3	—	53.0	13.5
>94	—	—	—	1.0	0.9	0.9	—	1.0	5.8
per 1 h.	1.1	0.2	3.3	3.0	94.6	112.1	2.3	336.0	27.8
Av. size	22.9	19.5	50.1	81.8	48.1	50.7	27.7	49.0	71.84
% <24 cm.	66.67	100.0	26.92	0	28.10	0	33.33	0	0.55

Supplementary Table 66 a. February—December 1938—45.

Territorial

Year:	1938	1938	1938	1938	1939	1939	1939	1940	1945	1945	1945	1945
Date:	$14/2$	$23/6$	$12-13/7$	$14/13$	$29-31/3$	$17-18/5$	$27-29/7$	$1-4/11$	$28/2-1/3$	$28-30/5$	$5/9$	$16-17/11$
Vessel:	Th	Th	Da	Th	Th	Th	Da	R	Sk	Br	Br	Br
Gear:	CT ₇₅	CT ₇₅	O ₅₀	CT ₇₅	CT ₇₅	CT ₇₅	O ₅₀	CT ₉₀	CT ₆₅	CT ₆₅	CT ₆₅	CT ₆₅
Hours:	10	4	10	10	10	5	7	$3\frac{1}{2}$	10	10	10	10
Total No.	83	621	18	12	7,059	70	104	1,477	82	665	126	160
<24 cm.	3.2	0.5	1.6	—	0.8	3.8	13.9	0.6	0.1	—	1.2	0.3
24—43	2.5	86.5	0.2	0.6	156.3	7.8	1.0	8.3	6.4	17.2	5.1	10.0
44—63	1.4	21.3	—	—	476.0	0.4	—	57.7	0.6	26.7	5.0	2.1
64—93	1.2	43.8	—	0.3	67.6	1.2	—	300.0	1.1	19.3	1.1	3.0
>94	—	3.3	—	0.3	5.2	0.8	—	55.4	—	3.3	0.2	0.6
per 1 hour	8.3	155.2	1.8	1.2	705.9	14.0	14.9	422.0	8.2	66.5	12.6	16.0
Av. size	35.3	54.5	18.9	60.7	52.0	69.6	20.8	77.0	38.7	58.2	45.1	44.9
% <24 cm.	38.6	0.3	89.0	0.0	0.1	27.1	93.3	0.1	1.2	0.0	9.6	2.0

Cod.

Table 67. Number per 1-hour Trawling, 1924—37.

Extra-territorial Station.

Year:	1924	1925	1925	1926	1927	1928	1929	1931
Date:	11—21/6	24/6	30/7, 7/8	25/6, 2/7	18/7	5/8	13/7	27/7
Vessel:	Da	Ex32	Da	Da	Da	Th	Th	Da
Gear:	O ₅₀	CT ₁₂₈	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	51	1	15	26	25	20	18	20
Total No.	1,774	14	348	62	173	6	31	47
<24 cm.	1.1	2.0	3.2	0.8	2.9	0.05	0.1	1.0
24—43	29.6	12.0	17.9	1.5	3.2	0.25	1.55	0.9
44—63	2.5	—	1.4	0.1	0.6	—	0.05	0.3
64—93	1.5	—	0.7	—	0.2	—	—	0.2
>94	0.04	—	—	—	—	—	—	—
per 1 h.	34.8	14.0	23.2	2.4	6.9	0.3	1.7	2.4
Av. size	35.95	29.3	34.3	27.1	28.4	29.5	31.5	33.2
% <24 cm.	3.04	14.28	13.79	33.87	42.20	16.67	6.45	42.55
Year:	1932	1933	1934	1936	1936	1937	1937	1937
Date:	21/8	14/5	14/5	2/6	6/7	23—24/6	25/5	27/10
Vessel:	Da	Da	Da	Nu	GB	Th	Nu	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	VD _{38.5}	CT ₁₂₀	VD ₇₅	CT _{35.5}	VD ₇₅
Hours:	28	11	4	2	4	10	2	14 1/2
Total No.	229	179	15	103	142	1,222	120	232
<24	6.1	10.7	2.0	—	12.0	0.6	1.0	0.1
24—43	1.9	5.4	1.5	36.5	22.5	57.2	21.5	6.1
44—63	0.1	0.2	—	14.5	1.0	37.3	15.5	3.2
64—93	0.1	—	0.3	0.5	—	26.5	20.0	6.2
>94	—	—	—	—	—	0.6	2.0	0.3
per 1 h.	8.2	16.3	3.8	51.5	35.5	122.2	60.0	16.0
Av. size	22.7	23.4	25.4	40.1	27.7	49.37	53.6	53.8
% <24 cm.	78.6	65.92	53.33	0	33.8	0.5	1.67	0.86

Supplementary Table 67 a. February—December 1938—45.

Extra-territorial

Year:	1938	1938	1938	1938	1939	1939	1939	1940	1945	1945	1945	1945
Date:	18—14/2	22/6	11—12/7	18/12	28/3	16—17/5	27—29/7	2—3/11	28/2—1/3	29/5	5—6/9	17/11
Vessel:	Th	Th	DA	Th	Th	Th	Da	R	Sk	Br	Br	Br
Gear:	CT ₇₅	CT ₇₅	O ₅₀	CT ₇₅	CT ₇₅	CT ₇₅	O ₅₀	CT ₉₀	CT ₆₅	CT ₆₅	CT ₆₅	CT ₆₅
Hours:	10	8	10	10	10	5	7	3	10	10	10	10
Total No.	76	677	153	8	907	54	3	23	7	905	411	85
<24 cm.	4.5	—	4.9	—	0.2	—	0.3	0.3	—	—	2.0	—
24—43	2.4	8.9	10.3	0.1	0.8	10.0	0.1	7.3	0.3	8.7	16.9	5.9
44—63	0.4	19.9	0.1	0.1	35.9	0.6	—	—	0.2	41.5	15.2	2.2
64—93	0.3	52.3	—	0.6	51.0	0.2	—	—	0.2	39.0	6.8	0.4
>94	—	3.6	—	—	2.8	—	—	—	—	1.3	0.2	—
per 1 hour	7.6	84.6	15.3	0.8	90.7	10.8	0.4	7.7	0.7	90.5	41.1	8.5
Av. size	24.7	68.1	26.9	66.4	67.0	31.3	24.7	28.5	51.3	62.0	47.6	38.9
% <24 cm.	59.2	0.0	32.0	0.0	0.2	0.0	66.7	4.3	0.0	0.0	4.9	0.0

Lemon Sole.

Table 68. Number per 1-hour Trawling. 1924—37.

Territorial Station.

Year:	1924	1925	1925	1925	1925	1926	1927	1928	1929	1929
Date:	²⁵ / ₆ , ⁶ / ₇	²⁴ / ₆	²⁴ / ₆	²⁵ / ₆	¹ / ₈	²¹ / ₆ , ¹ / ₇	¹ / ₈	⁵ / ₈	¹⁸ / ₇	²² / ₇
Vessel:	Da	Ex33	Ex34 ₁	Ex34 ₂	Da	Da	Da	Th	Th	Da
Gear:	O ₅₀	CT ₁₂₈	CT ₁₂₈	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	32	1	¹ / ₂	1	20	31	30	20	18	20
Total No.	504	0	42	10	196	219	341	104	111	267
<23 cm.	1.1	—	—	—	0.1	0.1	0.1	—	—	4.45
23—27	4.5	—	14.0	—	1.8	1.1	0.9	—	—	3.6
28—32	4.1	—	20.0	5.0	4.3	3.0	3.7	—	—	2.75
33—37	3.2	—	18.0	3.0	1.65	1.45	3.9	—	—	1.7
38—42	2.4	—	26.0	2.0	1.65	1.0	2.5	—	—	0.85
>43	0.5	—	6.0	—	0.3	0.35	0.7	—	—	—
per 1 h.	15.8	—	84.0	10.0	9.8	7.1	11.8	5.2	6.2	13.35
Av. size	31.0	—	34.6	33.6	31.8	32.1	34.2	—	—	26.4
Year:	1931	1932	1933	1934	1936	1936	1936	1937	1937	1937
Date:	²³ / ₇	¹ / ₇	¹⁸ / ₈	¹¹ / ₅	² / ₆	⁵ / ₇	¹⁸ / ₇	²⁴ / ₂₅ / ₅	²⁵ / ₅	²⁸ / ₁₀
Vessel:	Da	Da	Da	Da	Nu	GB	Th	Th	Nu	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	O ₅₀	VD _{38.5}	CT ₁₂₀	VD ₇₅	VD ₇₅	CT _{38.5}	VD ₇₅
Hours:	20	28	11	8	2	³ / ₂	² / ₃	⁷ / ₂ / ₃	2	13
Total No.	267	106	107	36	35	658	106	364 ¹	41	323
<23	4.5	1.15	0.6	0.5	2.5	61.14	3.9	10.0	0.5	4.8
23—27	3.6	2.2	3.6	1.75	4.0	49.1	12.5	18.4	8.0	13.5
28—32	2.8	0.95	4.2	1.1	6.5	43.4	14.6	5.0	6.0	6.1
33—37	1.7	0.5	0.8	0.6	0.5	22.9	7.3	5.0	5.0	0.5
38—42	0.9	0.4	0.4	0.5	3.0	8.9	3.4	8.3	1.0	—
>43	—	0.1	0.1	—	1.0	2.6	3.9	0.8	—	—
per 1 h.	13.4	5.3	9.7	4.5	17.5	188.0	45.5	47.5	20.5	24.9
Av. size	26.4	26.9	28.7	28.6	30.1	26.48	31.36	28.0	29.6	25.98

¹ of these 307 not measured

Supplementary Table 68 a. February—December 1938—45.

Territorial

Year:	1938	1938	1938	1938	1939	1939	1939	1940	1945	1945	1945	1945
Date:	¹⁴ / ₂	²³ / ₆	¹² / ₁₃ / ₇	¹⁴ / ₁₂	²⁹ / ₃₁ / ₃	¹⁷ / ₁₈ / ₅	²⁷ / ₂₉ / ₇	¹ / ₄ / ₁₁	²⁸ / ₂ / ₁ / ₃	²⁸ / ₃₀ / ₅	⁵ / ₉	¹⁶ / ₁₇ / ₁₁
Vessel:	Th	Th	Da	Th	Th	Th	Da	R	Sk	Br	Br	Br
Gear:	CT ₇₅	CT ₇₅	O ₅₀	CT ₇₅	CT ₇₅	CT ₇₅	O ₅₀	CT ₉₀	CT ₆₅	CT ₆₅	CT ₆₅	CT ₆₅
Hours:	10	4	10	10	10	5	7	³ / ₂	10	10	10	10
Total No.	74	265	298	234	169	730	363	155	26	126	417 ¹	61
<23 cm.	2.8	5.8	9.0	2.2	2.8	25.4	2.1	2.0	0.5	2.0	0.7	—
23—27	3.7	21.5	11.3	13.5	10.0	78.2	21.9	17.7	1.3	3.9	17.2	1.7
28—32	0.8	24.8	7.2	7.2	2.6	30.6	23.0	22.6	0.5	3.9	13.6	3.7
33—37	—	12.0	1.4	0.5	0.6	8.0	4.6	2.0	0.1	1.3	5.9	0.6
38—42	—	2.0	0.6	—	0.9	3.4	0.3	—	0.2	1.4	3.7	0.1
>43	0.1	0.3	0.3	—	—	0.4	—	—	—	0.1	0.6	—
per 1 hour	7.4	66.3	29.8	23.4	16.9	146.0	51.9	44.3	2.6	12.6	41.7	6.1
Av. size	23.9	28.8	25.3	26.2	26.1	26.1	28.1	27.8	26.3	28.5	29.6	29.9

¹ of these 52 not measured.

Lemon Sole.

Table 69. Number per 1-hour Trawling. 1924-37.

Extra-territorial Station.

Year:	1924	1925	1925	1926	1927	1928	1929	1931
Date:	11-21/6	24/6	30/7, 7/8	25/7-6/8	13/7, 27/7	5/8	13/7, 25/7	27/7
Vessel:	Da	Ex32	Da	Da	Da	Th	Th	Da
Gear:	O ₅₀	CT ₁₂₈	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀	O ₅₀
Hours:	51	1	19	26	25	20	18	20
Total No.	196	14	45	4	11	1	15	234
<23 cm.	0.4	—	0.2	—	—	—	—	1.3
23-27	1.3	1.0	0.6	0.04	0.08	—	—	2.0
28-32	0.84	9.0	0.9	0.1	0.08	—	—	4.55
33-37	0.57	3.0	0.6	0.04	0.16	0.05	—	2.0
38-42	0.47	1.0	0.1	—	0.08	—	—	1.3
>43	0.24	—	—	—	0.04	—	—	0.55
per 1 h.	3.8	14.0	2.4	0.15	0.44	0.05	0.8	11.7
Av. size	29.97	31.8	29.8	31.5	34.2	(37.0)	—	30.7

Year:	1932	1933	1934	1936	1936	1937	1937	1937
Date:	3-6/7	21/8	15/5	2/6	6/7	23-24/5	25/5	27/10
Vessel:	Da	Da	Da	Nu	GB	Th	Nu	Th
Gear:	O ₅₀	O ₅₀	O ₅₀	VD _{38.5}	CT ₁₂₀	VD ₇₅	CT _{38.5}	VD ₇₅
Hours:	20	11	4	2	4	10	2	14 1/2
Total No.	217	166	25	36	408	224	12	11
<23	1.3	3.45	1.0	9.0	18.25	3.9	5.0	0.1
23-27	4.5	5.4	2.0	4.0	39.25	7.0	0.5	0.5
28-32	3.45	4.0	2.0	5.0	39.0	8.3	0.5	0.2
33-37	1.0	1.0	0.5	—	4.75	2.5	—	—
38-42	0.5	0.9	0.5	—	0.5	0.6	—	—
>43	0.15	0.4	0.25	—	0.25	0.1	—	—
per 1 h.	10.9	15.1	6.25	18.0	102.0	22.4	6.0	0.8
Av. size	27.7	27.2	28.7	22.3	26.2	27.4	20.5	25.5

Supplementary Table 69 a. February-December 1938-45.

Extra-territorial

Year:	1938	1938	1938	1938	1939	1939	1939	1940	1945	1945
Date:	13-14/2	22/6	11-12/7	13/12	28-29/3	18/5	27-29/7	2-3/11	29/5	5-6/9
Vessel:	Th	Th	Da	Th	Th	Th	Da	R	Br	Br
Gear:	CT ₇₅	CT ₇₅	O ₅₀	CT ₇₅	CT ₇₅	CT ₇₅	O ₅₀	CT ₉₀	CT ₆₅	CT ₆₅
Hours:	10	8	10	10	10	5	7	3	10	10
Total No.	1	144	53	1	5	24	53	2	46	57
<23 cm.	—	0.9	0.8	—	—	0.4	1.7	—	0.1	—
23-27	0.1	5.8	1.9	—	0.1	2.0	3.0	—	0.7	1.2
28-32	—	9.1	1.8	0.1	0.2	2.0	2.3	0.3	1.5	2.0
33-37	—	1.9	0.8	—	0.2	0.4	0.4	0.3	1.5	2.0
38-42	—	0.3	—	—	—	—	0.1	—	0.7	0.5
>43	—	0.1	—	—	—	—	—	—	0.1	—
per 1 hour	0.1	18.0	5.3	0.1	0.5	4.8	7.6	0.7	4.6	5.7
Av. size	26.0	28.7	27.3	28.0	30.8	27.1	26.7	32.5	32.6	32.0

COMPOSITION AND DENSITY OF THE FISH STOCKS IN FAXA BAY AND BREIDA BAY ACCORDING TO EXPERIMENTAL TRAWLINGS

BY

ÁRNI FRIDRIKSSON

At the meeting of the Faxe Bay Sub-Committee in Copenhagen on May 27th 1938 it was recommended that experimental trawlings should be carried out in Faxe Bay and Breida Bay in order to compare the density of young halibut (see the Introduction, p. 5, point E). The trawlings were made on S/S "Thor" in May 1939. Table 71 gives the positions etc. of the trawling stations, which are moreover shown on the chart, Fig. 34. On the figure and in the tables (71, 72 and 73) the corresponding stations in Faxe Bay and Breida Bay are indicated with the same numbers (1 = South, extraterritorial) (2 = South, territorial etc.), the Faxe Bay stations being marked with F and the Breida Bay stations with B.

In Table 72 are given the numbers of cod, haddock, plaice, halibut and lemon sole caught per trawling hour at the different stations. The cod were much more numerous in all places in Breida Bay except for the fjords (6) where the case was exactly the reverse. On the average 4 to 5 (455 %) times more cod were caught in Breida Bay than in Faxe Bay (190 against 43 per trawling hour¹). On the other hand the haddock was much more numerous in Faxe Bay, the average number per trawling hour being 162 against only 14 or

¹ It is to be kept in mind that cod is not frequent in the warm water area at this time of year. During spawning time the cod is certainly many times more numerous in Faxe Bay than in Breida Bay.



Fig. 34. Trawling Stations in Faxe Bay and Breida Bay, "Thor", May 1939.

Table 71. Trawling Stations in Faxe Bay (F) and Breida Bay (B) May 1939.
(Research vessel "Thor")

Stat. No.	In Fig. 34	Locality	Central Position	Date
87	1 F	Fax. SE. Extr.	64°08.0'—22°23.5'	16—17/5
85	1 B	Breid. » »	65°00.5'—23°38'	15/5
88	2 F	Fax. SE. Terr.	64°03.8'—22°34.5'	17—18/5
84	2 B	Breid. » »	64°56.4'—23°43.0'	14—15/5
91	3 F	Fax. NE. Extr.	64°40'—22°43'	27/5
80	3 B	Breid. » »	65°18.5'—24°26.0'	13/5
90	4 F	Fax. NE. Terr.	64°43.5'—22°30.6'	27/5
79	4 B	Breid. » »	65°27.3'—24°13.0'	12/5
86	5 F	Fax. Middle	64°25.2'—23°18.8'	16/5
81	5 B	Breid. »	65°12'—24°07'	13/5
89	6 F	Fax. Fjord.	64°21.3'—21°43.4'	18/5
83	6 B	Breid. »	64°57.5'—23°17.0'	11/5

some 9 % in Breida Bay. Owing to a very great richness of plaice in the Grundarfjord (6 B) the average catch per trawling hour in Breida Bay exceeded that of Faxe Bay by about 91 %. The halibut was much more numerous in Faxe Bay, the average number caught per trawling hour being 41 and 6 respectively or 100 % in Faxe Bay against 15 % in Breida Bay. Finally the lemon sole in Breida Bay proved to be only 72 % of that taken in Faxe Bay per unit of gear.

The greater amount of cod in Breida Bay may be due to the deeper waters here than at the corresponding trawling stations in the Faxe Bay. On the other hand Faxe Bay seems to be of much greater value to the haddock and the halibut than Breida Bay, and, as shown in Table 73, especially for young fish. It is quite evident from the table that the stocks of the four species dealt with there consist of younger fish in Faxe Bay than in Breida Bay except for the plaice in the fjords (see Fig. 34, and 6 F and 6 B in Table 73). There is reason to assume, that the large number of plaice found in Grundarfjord (see Fig. 34, st. 6 B) is a local phenomenon and that the comparatively large number of small size-groups is due to slow growth owing to too great density rather than to predominance of young fish.

As far as the scanty observations described above reach, it seems reasonable to conclude that Faxe Bay is a much more effective nursery ground than Breida Bay, especially for halibut and haddock, the number of fish caught per unit of gear being many times greater here than in Breida Bay and very young fish much more predominant.

It must also be pointed out that all conditions in the two bays are entirely different in favour to Faxe Bay as a nursery. This is confirmed by the

Table 72. The Average Number per trawling hour in Faxe Bay (F) and Breida Bay (B) May 1939.

Stat.	Cod	Haddock	Plaice	Halibut	Lemon Sole
1 F	11	2	43	28	5
1 B	183 ¹ / ₂	85	7	¹ / ₂	50
2 F	14	572	253	116	146
2 B	298 ¹ / ₂	12	393	14	19
3 F	15	21	153	2 ¹ / ₂	4 ¹ / ₂
3 B	114	25	66 ¹ / ₂	7 ¹ / ₂	20 ¹ / ₂
4 F	11 ¹ / ₂	0	174	1	0
4 B	118	0	0	0	0
5 F	10	¹ / ₂	¹ / ₂	1	1
5 B	124	14 ¹ / ₂	4 ¹ / ₂	2 ¹ / ₂	52 ¹ / ₂
6 F	478 ¹ / ₂	0	126 ¹ / ₂	6 ¹ / ₂	1 ¹ / ₂
6 B	0	0	1,088	4	0
Means: F	42	162	113	41	43
B	190	14	216	6	31
B %	452	9	191	15	72
(F 100 %)					

fact, that the inner part of Breida Bay including the two large fjords, Gilsfjord and Hvammsfjord, is practically without fish, which may perhaps, at least partially, be due to the very strong tidal currents remaining here. These currents in the narrow straits between the very numerous islands are in some cases so strong that they have given rise to plants to produce electricity for domestic use (Brokey). As regards the outer more open parts of the Bay, where fish are abundant, we find nowhere the shallow-water banks, which give the great nursery value to Faxe Bay. In the southern part, comparable in positions with that part of Faxe Bay where the two experimental trawling stations are situated, the 150-meter depth line comes close to the coast as will be seen from the map.

Table 73. Size-Distribution in the various localities in Faxe Bay (F) and Breida Bay (B) May 1939.

Species Areas Stations	Haddock		Halibut		Plaice								Lemon Sole			
	1	2	2		1	2	4	6					1	2		
5-cm. classes	B	F	B	F	B	F	B	F	B	F	B	F	B	F	B	
80—84....	0.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
75—79....	2.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
70—74....	2.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
65—69....	2.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60—64....	6.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55—59....	12.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50—54....	3.5	0.1	6.7	—	6.5	—	—	—	—	0.7	—	—	—	—	—	—
45—49....	16.1	0.6	56.0	0.3	32.3	—	7.4	0.1	3.2	—	4.5	—	—	6.4	0.3	3.5
40—44....	9.4	9.7	32.2	1.2	37.0	0.5	18.5	0.2	13.7	0.3	9.8	—	0.1	—	34.6	1.0
35—39....	1.2	19.8	1.7	0.7	11.3	5.8	33.4	2.9	42.3	17.7	28.5	13.4	1.9	4.1	27.2	4.4
30—34....	18.8	30.9	3.4	4.7	1.6	39.1	29.6	11.1	36.7	58.5	42.1	48.2	17.1	12.5	15.3	11.3
25—29....	24.1	37.8	—	30.3	8.1	41.3	11.1	32.5	2.9	21.2	11.3	34.8	30.7	46.0	9.0	42.2
20—24....	—	0.5	—	55.0	—	10.2	—	45.8	0.3	2.0	—	3.6	33.7	33.3	7.0	38.0
15—19....	0.9	0.6	—	0.8	—	3.1	—	7.3	0.1	0.3	—	—	14.6	4.1	—	2.5
10—14....	—	—	—	7.0	—	—	—	0.1	—	—	—	—	1.9	—	—	0.3
Total %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Number	341	2,829	59	578	62	225	27	1,263	1768	306	133	253	1,088	24	202	730

CATCHES FROM SEINE-NETTERS, WITH SPECIAL REGARD TO FAXA BAY

BY

ÁRNI FRIDRIKSSON

Throughout 1938 special statistics were collected as to the Icelandic Danish-seine fishery. Unfortunately, it was not possible to specify the statistics according to fishing grounds, but as the fish has been landed at the places shown on the chart Fig. 35 in this paper and always in fresh or temporarily iced condition, it may be assumed that the records from each landing place originate from fishing grounds in the near vicinity. It is possible, that some of the catches landed in the Faxa Bay harbours, may be made outside Faxa Bay, but we must hope that such inaccuracy may be compensated by catches taken in Faxa Bay, but landed on other parts of the coast.

In Fig. 35 the fishing grounds round Iceland have been subdivided into 6 areas, and the landings have been recorded according to that. The landing places are for the S. coast (Area 1) the Westman Islands only, for Faxa Bay (Area 2) Keflavík, Reykjavík

and Akranes, for Breida Bay (Area 3) Stykkishólmur, for the NW. coast (Area 4) Bildudalur, Flateyri, Isafjörður, for the N. coast (Area 5) Akureyri, Husavík, Thorshöfn and for the E. coast (Area 6) Seydisfjord and Nordfjord. According to this sub-division of the Icelandic area, the total yield in the year 1938 has been as shown in Table 74 (tons of fresh fish).

Thus, as shown in the table, the total catch by seine-netting approaches 4,000 tons, half of which, by weight has been landed in the three Faxa Bay harbours. Next comes the S. coast whereas the fishery off the E. coast has been less than 5 % of the total.

It is also interesting to study the composition of the catches from the various areas according to species as shown in Table 75.

Except for the S. coast, where the lemon sole seems to play the most important rôle, the plaice

Table 74. Total Landings according to areas and species.

Species:	Area: 1 (S.)	2 (Faxa B.)	3 (Breida B)	4 (NW.)	5 (N.)	6 (E.)	Total (tons)
Plaice.....	146.5	551.5	158.8	326.3	290.5	166.0	1,639.6
Lemon Sole ..	435.4	201.4	4.1	2.2	9.5	1.1	653.7
Witch.....	102.0	36.2	—	2.8	1.4	—	142.4
Dab.....	+	3.2	—	0.6	+	—	3.8
Megrim.....	20.6	14.7	—	0.1	2.3	0.1	37.8
Halibut.....	24.1	59.0	8.2	15.7	24.7	3.6	135.3
Cod.....	16.6	662.1	88.5	34.1	64.1	—	865.4
Haddock.....	29.9	234.3	4.8	27.6	19.5	—	316.1
Catfish.....	2.9	93.5	10.8	+	23.3	—	130.5
Skate and Ray	2.4	48.9	1.4	3.1	2.3	—	58.1
Total	780.4	1,904.8	276.6	412.5	437.6	170.8	3,982.7

Table 75. Composition of Catches from different areas (%).

Species:	Area: 1 (S.)	2 (Faxa B.)	3 (Breida B)	4 (NW.)	5 (N.)	6 (E.)
Plaice.....	18.8	28.9	57.4	79.1	66.4	97.2
Lemon Sole ..	55.8	10.6	1.5	0.5	2.2	0.6
Witch.....	13.1	1.9	—	0.7	0.3	—
Dab.....	—	0.2	—	0.1	—	—
Megrim.....	2.6	0.8	—	—	0.5	0.1
Halibut.....	3.1	3.1	3.0	3.8	5.6	2.1
Cod.....	2.1	34.7	32.0	8.3	14.7	—
Haddock.....	3.8	12.3	1.7	6.7	4.5	—
Catfish.....	0.4	4.9	3.9	—	5.3	—
Skate and Ray	0.3	2.6	0.5	0.8	0.5	—
Total	100.0	100.0	100.0	100.0	100.0	100.0 %



Fig. 35. 1 = S. coast, 2 = Faxa Bay, 3 = Breida Bay, 4 = NW. coast, 5 = N. coast and 6 = E. coast. Also the landing places are shown on the chart. Ve = Westman Islands, K = Keflavik, R = Reykjavik, A = Akranes, St. = Stykkisholmur, F = Flateyri, Is = Isafjord, A = Akureyri, H = Husavik, Th = Thorshöfn, S = Seydisfjord and N = Nordfjord.

is everywhere the predominating species in this fishery. In Faxa Bay, however, the percentage is surpassed by that of the cod by weight. A glance at the figures might give the idea that the plaice was most numerous at the E. coast and least numerous for instance in Faxa Bay, but that is not

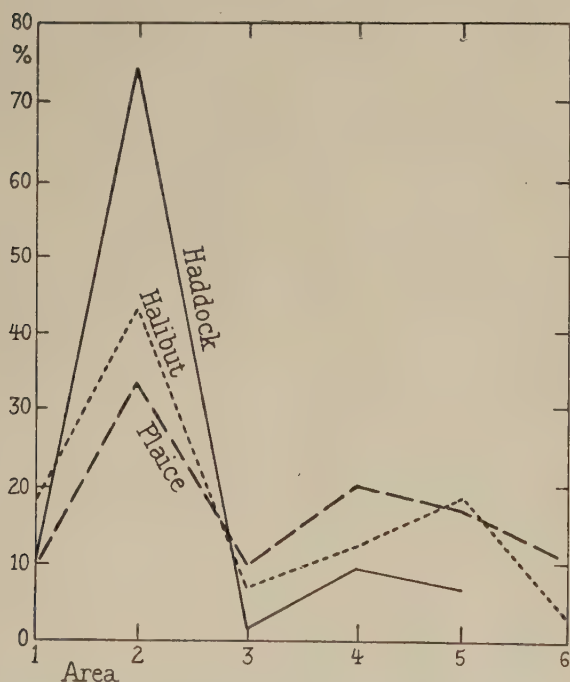


Fig. 37. Relative share of the different areas in the total Seine-Netting Yields of Haddock, Plaice and Halibut. It will be seen that the Faxa Bay region has given by far the greatest quantities.

true. This is evident if we consider the extent of the different areas as defined above. Their sizes in naut. sq. miles are:

	Territorial waters	Extraterr. to 200 m.	Total
S. coast ..	1,053	5,262	6,315
Faxa Bay	615	1,890	2,505
Breida Bay	1,122	4,123	5,245
NW coast	672	4,270	4,942
N. coast..	1,917	5,768	7,685
E. coast..	922	4,688	5,610

Thus we see that the low-water area in and outside Faxa Bay is much smaller than off any other part of the coast in the sub-division we are using here. Nevertheless we have already seen that the greatest quantity of plaice, haddock and halibut has been caught in Faxa Bay as also shown by the following figures, which give the percentage shares of the different areas in the total catch of the different species.

Table 76. The Percentage Share of each species in different areas.

Area:		Plaice	Haddock	Halibut
S. coast	(1)	9.0	9.5	17.8
Faxa Bay	(2)	33.6	74.1	43.6
Breida Bay	(3)	9.7	1.5	6.1
NW. coast	(4)	19.9	8.7	11.6
N. coast	(5)	17.7	6.2	18.3
E. coast	(6)	10.1	0.0	2.6
Total		100.0	100.0	100.0

It is therefore evident that although Faxa Bay is by far the smallest of our six areas, it has yielded 33.6 % of the plaice, 74.1 % of the haddock and 43.6 % of the halibut taken in Icelandic waters by Danish seine in the year 1938.

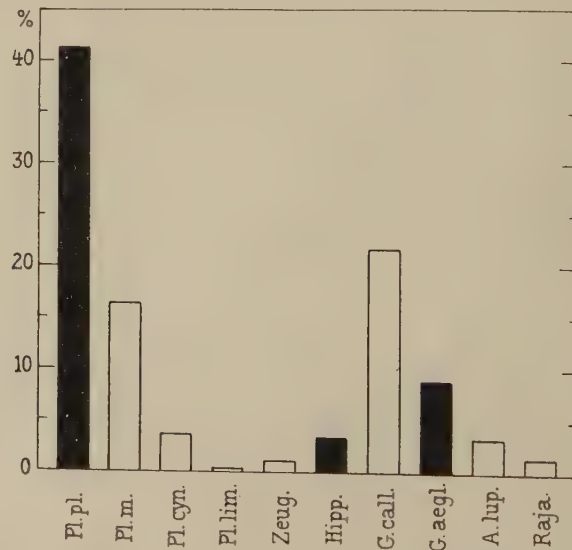


Fig. 36. The Percentage Composition of the Danish Seine Catches in all Icelandic Waters according to Species. The quantities of Plaice, Haddock and Halibut are shown with black columns.

THE COMPOSITION OF CATCHES FROM LONG-LINE AND TRAWL IN FAXA BAY

BY

ARNI FRIDRIKSSON

During December 1938 to March 1939 it was possible to study the composition of long-line catches from Faxa Bay. The investigations were carried out by counting every fish caught on certain boats from Reykjavik and Akranes during this period. In Table 77 the results of these countings are recorded in percentages indicating the numbers of the different species. Species numbering less than 0.05 % are indicated by a + sign in the table. Taken as a whole this material of 67,747 specimens shows that the cod forms the bulk of the entire catch: 91.2 % while the haddock is represented by 2.2 % only, the halibut by 0.2 % and the plaice by less than 0.05 %. The table confirms that the long-line fishing in the bay is based on cod.

In Table 78 the total number of fish counted is recorded in the first column, the percentage frequencies of the species in the second column, and in the last one the number per 10,000 hooks ap-

proximately corresponding to a day's work by a long-line vessel. Thus, a catch averaging 1,245 cod per day, may reckon on some 30 haddock, 2 halibut and practically no plaice to be taken.

It is interesting to compare these results with the records made by "Thor" in Faxa Bay (March 1939) and the yield per day's work with her 75 feet trawl, if the day's work is fixed as 18 trawling hours. It is sufficient to refer to the Tables 79 and 80 where we find the total number caught, the percentage frequencies of the species and the absolute number of each species caught during a day outside (Table 79) and within (Table 80) the territorial limit.

Comparing the Tables 78—80 and only taking the haddock, halibut and plaice into consideration, we find the yield per day's work as shown in Table 81.

Table 77. Composition of Long-line Catches from Faxa Bay.

Species:	1938	1939		1939		1939	Total:
	Dec. Reyk.	January Reyk.	Akranes	February Reyk.	Akranes	March Akranes	
<i>Gadus callarias</i>	94.1	94.9	92.8	95.1	92.0	88.9	91.2
<i>Gadus aeglefinus</i>	5.6	1.4	2.5	0.2	2.6	1.8	2.2
<i>Anarhichas lupus</i> ..	—	1.1	1.9	4.3	1.9	3.3	2.4
<i>Raja radiata</i>	—	1.5	1.3	0.2	1.6	3.0	2.1
<i>Brosme brosme</i>	—	0.2	0.4	—	1.2	1.1	1.0
<i>Molva vulgaris</i>	—	0.1	0.2	—	0.2	1.0	0.5
<i>Sebastes</i> sp.	—	0.6	0.2	—	0.2	0.3	0.2
<i>Hippoglossus vulg.</i> ..	0.3	0.2	0.3	0.1	0.1	0.2	0.2
<i>Raja batia</i>	—	—	0.2	—	0.1	0.1	0.1
<i>Molva byrkjelange</i> ..	—	—	0.1	—	+	0.1	+
<i>Pleuronectes limanda</i>	—	—	+	0.1	+	0.1	+
<i>Gadus virens</i>	—	—	—	—	+	+	+
<i>Gadus merlangus</i> ...	—	—	+	—	—	+	+
<i>Anarhichas minor</i> ..	—	—	+	—	+	+	+
<i>Pleuronectes platessa</i>	—	—	—	—	—	+	+
<i>Pleur. microcephalus</i>	—	—	—	—	—	+	+
<i>Anarhichas latifrons</i>	—	—	—	—	—	+	+
<i>Drepanops. platess.</i>	—	—	+	—	+	+	+
<i>Acanthias vulgaris</i> .	—	—	—	—	+	+	+
Total	100.0	100.0	99.9	100.0	99.9	99.9	99.9
Number	638	3,786	10,865	1,260	26,935	24,263	67,747

Table 78. Composition of Long-line Catches in Faxe Bay, Yield per Day's Work etc.

Species:	1938—1939 Dec.—March Number	%	Number per 10,000 hooks
<i>Gadus call.</i>	61,797	91.2	1245
<i>Gadus æglef.</i>	1,505	2.2	30
<i>Anarh. lup.</i>	1,625	2.4	33
<i>Raja rad.</i>	1,424	2.1	29
<i>Brosn. brosm.</i> ...	649	1.0	13
<i>Molva vulg.</i>	331	0.5	7
<i>Sebast. sp.</i>	147	0.2	3
<i>Hippogl. vulg.</i> ..	114	0.2	2
<i>Raja batis.</i>	57	0.1	1
<i>Molva byrkel.</i> ...	33	+	1
<i>Pleur. lim.</i>	18	+	—
<i>Gad. vir.</i>	6	+	—
<i>Gad. merl.</i>	8	+	—
<i>An. min.</i>	9	+	1
<i>Pleur. plat.</i>	3	+	—
<i>Pleur. micr.</i>	3	+	—
<i>An. lat.</i>	1	+	—
<i>Drepanops. pl.</i> ..	16	+	—
<i>Acanl. vulg.</i>	1	+	—
Total	67,747	100.0	1,365

Table 81. Yield of Haddock, Halibut and Plaice per Day's Work by Trawl or Long-line.

	Long-line	75-feet Trawl	
	Extraterr.	Extraterr.	Territor.
Haddock.....	30	51	2,050
Halibut.....	2	22	211
Plaice.....	<1	1,500	2,821

Table 79. Composition of Trawl Catches from Extra-territorial Waters in Faxe Bay, March 1939 and the Yield per Day's Work.

	Total 30 hours	%	per 18 Tr. hours
<i>Pl. plat.</i>	2,500	31.7	1,500
<i>Pl. cyn.</i>	1,481	18.7	890
<i>Gad. call.</i>	1,387	17.6	833
<i>Raja bat.</i>	745	9.5	447
<i>Sebast. mar.</i>	695	8.9	417
<i>Raja rad.</i>	553	7.0	332
<i>An. lup.</i>	141	1.8	85
<i>Gad. æglef.</i>	85	1.1	51
<i>Zeug. meg.</i>	85	1.1	51
<i>Pl. micr.</i>	80	1.0	48
<i>Hippogl. vulg.</i> ..	36	0.5	22
<i>Gad. merl.</i>	30	0.4	18
<i>Molva vulg.</i>	30	0.4	18
<i>Molva byrkel.</i> ...	15	0.2	9
<i>An. minor.</i>	10	0.1	6
Total	7 873	100.0	4,727

Table 80. Composition of Trawl Catches from Territorial Waters in Faxe Bay, March 1939 and the Yield per Day's Work.

Species:	Total 32 Tr. hours	%	Per 18 Tr. hours
<i>Gad. call.</i>	8,435	43.7	4,745
<i>Pl. plat.</i>	5,016	26.1	2,821
<i>Gadus æglef.</i> ..	3,644	18.9	2,050
<i>Raja rad.</i> ...	1,291	6.7	726
<i>Hipp. vulg.</i> ..	375	1.9	211
<i>Gadus merl.</i> ...	183	0.9	103
<i>Pl. micr.</i>	179	0.9	101
<i>An. lup.</i>	168	0.9	94
<i>Gad. vir.</i>	9	—	5
<i>Raja bat.</i> ...	4	—	2
Total	19,304	100.0	10,858

THE ICELANDIC TERRITORY

BY

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I. In ancient times and far into the Middle Ages, the science of navigation and ships and devices to aid navigation were of such a kind that voyages on the open ocean with them were very difficult and dangerous. Deep-sea fishing was then practised only or at least mainly along the coasts. Only on ships equipped for viking raids or for commerce did men venture out into the ocean. The fishing vessels were so small and of so weak construction that they were not capable of sailing out on to the open ocean. Communication along the coast was also infrequent as compared with modern times, and was also carried on by viking ships or trading vessels. For these reasons there was no need for any nation to ensure for itself or its subjects special rights of traversing or working on the sea around its country. The greatest civilised power of ancient times in Europe, the Romans, did not therefore need to lay down laws regarding territorial rights in the waters around its boundaries. The Romans accounted the sea as "*res communis*", like the air and the light of the sun. (Inst. 2-1-1, Dig. 1-8-12-1 and 4, 43-8-3-1 and 47-10-13-7). The Romans, therefore, had no definite territorial waters. In the later Middle-Ages, when better ships were built and men began to sail over the open sea more or less as they wished, then several of the greater maritime nations began to make claims for a monopoly over various stated parts of the ocean, e. g. Spain and Portugal over sailings on the route to India and the West Indies, Norway over the sea between Norway and Iceland and Greenland, Denmark over the Baltic, England over the North Sea, etc. Spain wished to prevent the Dutch from sailing south of the Equator and England and Holland differed as to which held the supremacy of the seas, etc. In the beginning of the sixteenth century scholars began to write about the maritime rights of nations. HUGO GROTIUS wrote a book called "*Mare liberum*" which was challenged by the Englishman SELDEN with his "*Mare clausum*". GROTIUS' interpretation conquered, as is known. Since then the freedom of the seas has been recognised by all nations.

The Italians very early laid claim to some control over the seas bordering their country. But there was no rule that any country had special rights over its territorial waters. In the beginning of the eighteenth century the Dutchman VAN BYNKERSHOEK wrote a treatise "*De dominio maris*" and therein made a distinction between the open sea and territorial waters. He concluded that the strip of sea bordering the shores was under the dominion of the state owning the country. But there was still the question as to the extent of these territorial waters to be settled. It was to be determined by the distance out to sea at which it was possible to defend the coast with the weapons then available. It was calculated in accordance with the distance out to sea which a cannon based on the coast could fire (*potestatem terræ finire, ubi finitur armorum vis*).

The proposition that each state should have some control over the waters surrounding its shores has gained general recognition. The difficulty lies in deciding what distance out to sea that control should reach, i. e. how wide the limit of territorial waters should be. Determination by means of the range of guns has naturally proved entirely impracticable. In practice each country has imposed its own regulations concerning this. For instance, Denmark, Norway and Sweden say 4 nautical miles, England and France 3 nautical miles, etc. And although a state may claim for instance 3 nautical miles as a general rule yet it may for other purposes claim territorial rights over a wider area, e. g. for the control of customs, sanitary precautions, prohibition of alcohol, etc. In addition there are international agreements to be considered, where two or more states have agreed between themselves on the width of territorial waters in certain defined cases — especially as regards fisheries.

II. Regulations as regards territorial waters (in the modern sense of the term) round Iceland do not of course date from the settlement of the country nor were they known for some centuries after that. The harvest of the sea was free to all, Icelanders as well as foreigners. Iceland was so distant from other countries that there was then

no need to limit anyone's right to utilise the ocean around it. Only those individuals who owned land bordering on the sea were granted a kind of monopoly of the products of the sea bordering their estates. The landowner owned all the catch in "netlög". This meant all the catch from the tract of sea between the low-water mark of spring tides so far out to sea as a seal-net 20 meshes deep touched bottom with the floats on the surface (Grágás I, pp. 125, 133, II, pp. 514, 515, III, pp. 384, 385, 406, 407). Outside this boundary fishing was free to all, natives or foreigners, it seems. Landowners also had the right to claim timber, whales, birds or fishes, floating in the sea near the shore for as far out from the low-water mark of spring tides as it was possible to discern an unflattened fish on the side of a ship, i. e. the side facing the shore. The fish must be cod of one ell between the lugs (an ell was then between 18 and 19 inches). The foreshore and this area of the sea together were called "rekamark landeiganda" (i. e. the boundary of a landowner's right to flotsam and jetsam), and the sea beyond that was called "almenningur" (i. e. *res communis*). In the communal area of the sea flotsam might be collected by anyone (Grágás I, p. 125, cf. I, p. 132, 133, II, 512, 513, 532, 533, III, 381, 383, 404, 405, 406, 407). Both these conceptions, of the netlaying and the "rekamark", were very indefinite. Fjords and inlets seem to have been accounted as part of the country, if we may judge of this from the clause in "Grágás" I, 71, saying that skippers (i. e. owners of vessels) should receive full payment for the vessel if it came so close to the land that a promontory from the land reached past the stem of the ship.

In "Jónsbók" (a later code of laws, taken into use in 1281) the above-mentioned regulations from "Grágás" are repeated unchanged (section on jetsam, chapters 2, 6, 7, 8 and 11). These regulations remain unchanged until the decree of 20th June, 1849. Then the landowner's right to catches off his foreshore (netlög) was fixed at a distance of 60 fathoms from the low-water mark of spring tides straight out to sea. The landowner was also at this date granted the sole right to seal hunting from low-water mark (spring tides) to 120 fathoms out, this was called nótlög. The ruling with regard to flotsam remained on the other hand unchanged.

After Iceland came under the dominion of the King of Norway (1262—1264), the king began to forbid all save those who had a licence from him to sail to Iceland for trading purposes. An amendment of 1348 made a general rule to this effect and among other provisions it forbade all, Norwegians as well as others, to sail with their wares to all the king's dependencies (which included Iceland).

With this Iceland was to be a "close preserve" like Greenland has been for a long period. There would be no necessity until the end of the fourteenth century to forbid fishing by foreigners off

Iceland, as there is no evidence to show that foreigners ever did fish off Iceland then. But in the beginning of the fifteenth century the English began to fish here. It is recorded in Icelandic annals, for instance, that in the year 1413 thirty or more English fishing vessels came to this country. The King of Norway regarded this as trespassing on his rights and made complaint of it to the King of England (in 1415) who forbade his subjects to go to Iceland for fishing in greater numbers than the old custom had been. This prohibition does not seem to have been effective and English fishermen caused various disturbances in Iceland in the years 1420—1440. In the so-called "Long amendment" of King Christian I, dated 1450, Englishmen and Irishmen were forbidden to go to Iceland on pain of death and forfeiture of goods. In the beginning of the fifteenth century the Germans also began sailing to Iceland, although it was prohibited to them as well as to Englishmen. The Germans manned boats based on the shore stations in Iceland, but had few fishing smacks to begin with, the distance from their home country being greater than for Englishmen.

The Icelanders disliked foreigners spending the winter in the country and fishing from it, and special regulations prohibiting the practice were introduced. In the sixteenth century Icelanders began to protest against foreign fishing smacks operating near the coast. Already in 1500 we find "such fishing vessels as use long lines" judged to be proscribed and entitled to be seized by anyone wheresoever they were found. It was thought that the fishing vessels brought many evils. Their crews committed robbery and violence, they were insulting to womenfolk when they came ashore and were thought to spoil the fishing for the inhabitants of the country. The king provided no protection. In 1545 it was laid down that they should pay a tax, 2 angels on each ship, but this, of course, was of little use. The situation remained the same throughout the 16th century. In 1593 the inhabitants of Iceland petitioned their king to prohibit fishing vessels from operating close to the land. But although the king claimed to control all sailings on the northern seas yet he did little or nothing to maintain his sway. And up to this point no laws had been laid down regarding the territorial waters of Iceland. The first regulations which resemble laws on that point are in the monopoly laws of the 17th century.

The Danish monopoly of trade with Iceland began in the beginning of the 17th century. For the first thirty years of the monopoly no regulations are to be found concerning Icelandic territorial waters. The first of such regulations is dated the 16th December, 1631, when the traders holding the Danish monopoly were granted the sole right to whaling and fishing off Iceland. The decree says that the traders may seize the ships of other nations, whalers and fishing vessels, which approach

the country, English vessels if they are within 4 Danish miles of the coast (1 mile Danish = $\frac{1}{15}$ of a degree of latitude), and other ships if they are within 6 Danish miles of the coast when found. Vessels which were seized were to be confiscated. On June 18th, 1634, the traders of the monopoly were granted the same kind of authority for whaling from the Faroe Islands, but without the right of seizure. And, of course, it was forbidden for foreign fishing vessels to land in Iceland. These regulations show a great change in the king's attitude as regards his authority over the northern seas. They are now "*mare liberum*" except for a belt 4—6 miles wide round the country. In 1660 a certain Danish subject was granted a licence for 20 years to hunt whales, 1— $\frac{1}{2}$ miles from the coast of Iceland, and in 1682 four specific persons are granted a licence to trade with Iceland, while simultaneously all others, save these four and the Icelanders themselves, were forbidden to fish within 4 miles (Danish) of the shore, no difference being made this time between the English and others. This was certainly intended to protect the fisheries for the inhabitants of Iceland, though it was to small purpose. The harsh Danish monopoly lasted until 1787. In the main the ruling seems to have been until that date that only the inhabitants of the country and the traders who held the monopoly might fish off the coasts and for a width of 4 miles (Danish) round the shores. A royal proclamation of 18th August 1786 made the fishing round the coasts of Iceland free to all subjects of the King of Denmark and Norway (who was also King of Iceland), and a little later, a decree of 13th June 1787 forbade all foreign nations to fish off the country or to enter the fjords or inlets, except in need, on peril of confiscation of both ship and cargo. The provisions with regard to the 4-mile limit were not specifically mentioned in this and there are some grounds for thinking that the limit was to be 3 miles (Danish). The regulations regarding confiscation of ship and cargo were most likely never enforced.

As regards the territorial waters of Denmark and Norway it was decided by the so-called "kaperreglement" of 28th March, 1810, that during a time of war ships might not be seized at sea within one mile (Danish) of a neutral or friendly coast, reckoning the distance from the low-water mark of spring tides from the mainland or from the outermost islands which were not covered by the sea at high tide (royal decree of 22nd February, 1812). Since that time the limit of Danish (and Norwegian) territorial waters has always been accounted as 1 Danish mile or 4 nautical miles, unless otherwise agreed upon by treaty. The same ruling applies in Sweden according to Regulations for the Seizure of Vessels dated the 8th July, 1788, and 12th April, 1808. But there were no alterations of the definition of Icelandic territorial waters.

About 1830 the Icelanders complained bitterly of the encroachment of Dutch, French and Belgian

fishermen on Icelandic grounds, and proposed that the limit of the territorial waters should be fixed at 3—4 Danish miles from the shore. In its reply to these complaints, dated 11th December, 1833, the Danish Foreign Ministry says that Danish patrol vessels have tried to prevent foreign fishing vessels from fishing within this area but that their authority to do so had been challenged, and indeed it would be more in accordance with modern ideas of territorial waters for their extent to be fixed at 1 mile (Danish) round Iceland. A few years later in reply to an enquiry as to the right of Englishmen to fish off the coasts of Iceland, it was said that they were forbidden to fish within one Danish mile of the coasts of Iceland. On 3rd May, 1846, a royal letter was published saying that the officers commanding patrol vessels should be reminded to exercise special discretion in carrying out their duties, and that the prohibition on foreigners' fishing off Iceland shall not be enforced as strictly as had been the case, but no definition is given of the width of the territorial waters of Iceland. In the year 1859 this question arises again. The Ministry then considering the matter was inclined to the view that the one-mile (Danish) limit should be adhered to, except that foreign fishing vessels should be forbidden to fish in fjords and bays, and the Danish Government announced this decision to the governments of the countries. The one-mile (Danish) limit may now be accounted legally accepted. But the wording of the prohibition of fishing by foreigners in fjords and bays is very vague, and the patrolling of the territorial waters by Denmark was always unsatisfactory. The "Althing" complained of this again and again in the years 1859 to 1867, and demanded that definite regulations should be laid down about the territorial waters. Finally regulations on this matter were made by an act of 12th February 1872, whereby a fine of 10 to 200 Thaler was imposed on foreigners (i. e. others than Danes and Icelanders) fishing "within the limits of territorial waters as defined by international law or as they may have been fixed for Iceland by special agreement with other nations". This cannot be called a clear definition, because it is certain that international law had not then fixed any limits for territorial waters.

This was the situation until an agreement was made between Denmark and Great Britain on 5th May, 1902, concerning the arrangement for fishing by Danish and British subjects in the waters around the Faroe Islands and Iceland. The dispositions with which we are here concerned are Para. I, II, cf. III of the Agreement. Para. II says that subjects of the King of Denmark "alone have the right to fish along the coasts of the islands (i. e. Iceland and the Faroes) together with the inlets, rocks and shoals thereto appertaining, three quarters of a mile (i. e. 3 nautical miles) out from the outermost limits reached by the low-water mark". This therefore fixes the limit of territorial waters at $\frac{3}{4}$ ths

Danish mile from the low-water mark of spring tides. If rocks or islands occur within this distance from land then the limit is reckoned from low-water mark on such rocks or islands. But if more than 6 quarters of a mile (Danish) separates the mainland from an island then the island has a separate area of territorial waters, e. g. the Westman Islands. The old regulations relating to the prohibition of fishing in fjords or bays are amended so that in such places the three-mile limit is reckoned from an imaginary straight line drawn across the bay at the point nearest its mouth where the width does not exceed 10 miles (nautical). Even though the fjord or opening may be wider further in, as much as 6 miles (nautical) or more, yet it is "*mare clausum*" if ness or capes project nearer the mouth so long as the distance between them is not more than 10 miles. Breidafjörður and Faxa Bay will be, according to this ruling, outside territorial waters, as is known.

This agreement is only concerned with fishing and directly only with British fishing. But not only was the right reserved for other nations to accept the agreement but also they may acquire the right by the "most favoured nations" clause. Finally it seems to be the fixed custom of the Icelandic law-courts when judging cases of offences by foreigners against the fisheries regulations, no matter what the nationality of the offenders, to apply the three-mile (naut.) limit and in general the terms of the agreement with Great Britain.

The agreement between Denmark and Great Britain only applies to fishing as mentioned above. As regards the Icelandic territorial waters in other connections, e. g. neutrality in war, sanitary precautions, precautions necessary owing to the law of prohibition, rights of judicial process against offenders against the law, etc., there are no agreements between Iceland and other countries. There is no general international ruling about territorial waters. Each nation has decided on its own account how wide an area it will define as territorial waters round its shores. It is a different matter whether other nations consider such regulations inimical to their interests. Iceland has fixed the limit of her territorial waters in two connections. According to the Act concerning the Control of Alcohol No. 33/1935, Par. 5, and the Customs Duties Act No. 63/1937, Par. 8, the limit is placed at 4 nautical miles out to sea from the low-water mark of spring tides, reckoning from the outermost rocks and skerries which project above the surface of the sea. Fjords and bays are included in territorial waters 4 naut. miles out to sea from a line drawn across where the distance between headlands nearest to the mouth of the fjord is 12 naut. miles. Accordingly illegal importation of alcohol is an offence if it is brought within Icelandic territorial waters with the intention of putting it ashore and customs inspection of all ships is authorised in Icelandic territorial waters as defined in the Customs Laws.

REGULATIONS OF THE FISHERIES IN TERRITORIAL WATERS

BY

SVEINN BJÖRNSSON

For hundreds of years endeavours have been made to maintain certain territorial limits for the fisheries of the Icelandic coasts, varying at different periods, the greatest limit being 6 Danish miles (24 naut. miles). But since only the 3-mile limit, prescribed by the Convention with Great Britain of 24th June 1901, has been retained, the other limits ordained before that time have now only an historical or academic interest and we need not dwell upon them further.

Articles II and III of the 1901 Convention, in force since 1903, read as follows: —

Article II.

The subjects of His Majesty the King of Denmark¹ shall enjoy the exclusive right of fishery within the distance of 3 miles from low-water mark along the whole extent of the coasts of the said islands, as well as of the dependent islets, rocks, and banks.

As regards bays, the distance of 3 miles shall be measured from a straight line drawn across the bay, in the part nearest the entrance, at the first point where the width does not exceed 10 miles.

The present article shall not prejudice the freedom of navigation or anchorage in territorial waters accorded to fishing boats, provided they conform to the Danish² Police Regulations ruling this matter, amongst others the one stipulation that trawling vessels while sojourning in territorial waters shall have their trawling gear stowed away inboard.

Article III.

The miles mentioned in the preceding article are geographical miles, whereof 60 make a degree of latitude.

¹ 1918—1944 the King of Denmark and Iceland.

² Now: Icelandic.

This territorial limit also applies to Faxa Bay. Its introduction has not met with any difficulties in practice, except perhaps for a few cases concerned with the interpretation of the regulations about "bays".

With reference to Statute No. 33 of 19th June 1922, the right to carry on fishing within Icelandic territorial waters is reserved exclusively to citizens of Iceland¹ on boats belonging to Iceland. It is not allowed fishermen of foreign countries to carry on any sort of fishing within the territorial limits; further, to make any station on land or in harbour for the purpose of carrying on the fishery outside the limits; further, to handle or prepare the catch for trade either within territorial waters or in harbours.

The main regulation is, therefore, that foreign fishermen at Iceland have only the right to fish outside the territorial limits, whilst all fisheries within the limits are reserved for Icelandic citizens. But from the latter an exception is made in the case of trawl fishing. This fishery is forbidden within territorial limits to all trawlers, whether foreign or Icelandic. Yet the Ministry may give dispensation from this to motor-boats belonging to Icelandic citizens, fishing for prawns with the ordinary prawn-trawl, within certain prescribed areas in territorial waters. Such a fishery is not carried on in Faxa Bay, where no such dispensation has been granted. — Further, all trawlers, both Icelandic and foreign, must have their trawling gear stowed away inboard, when they come within territorial waters.

The general prohibition against trawl fishing within territorial waters was first introduced by Statute of 9th August 1889, and altered later several times, especially with regard to the penalties exacted.

¹ As also Danish citizens until otherwise agreed.

Fishing with the Danish seine inside the territorial limits has been forbidden since 1928 for certain periods, varying somewhat for two different parts of the territory, namely, in terms of the existing regulations: —

- 1) For the area from Eystra Horn (S. E. Iceland), south and westwards round the island to Straumnes (N. W. Iceland) the prohibition applies to the period from 1st January to 15th May and the whole of December.
- 2) For the area from Straumnes to Eystra Horn, north and eastwards round the island, from 1st January to 15th June and the whole of December.

Since Faxe Bay lies in the first area, the Danish seine may be used there (by Icelandic citizens) inside the territorial limit during the period from 16th May to 30th November each year. Vessels over 30 tons gross, however, have only the right to fish with Danish seine on the territory from 1st October to 30th November.

As of historical interest only it may be mentioned, that by Statute of 12th November 1875 the use of cod-nets was forbidden in Faxe Bay before 14th March in each year. This prohibition was raised by Statute of 20th October 1905.

Similarly, it is only of historical interest to note, that by virtue of the Statute of 14th December 1877 and local bye-laws of respectively 9th June 1885 and 11th January 1888 it was forbidden to set out cod-nets at certain specified places in Faxe Bay. These regulations have been discarded long ago.

It may be remarked, that these regulations existed at a period, before trawl fishing had begun.

In conclusion, the principal existing regulations may be summarized as follows: —

1. The territorial limit for Faxe Bay is 3 naut. miles, measured according to the rules in Art. II and III in the Convention of 24th June 1901.

2. Fishing within territorial waters and preparation of catch for sale, also fishing stations within the limit or in harbour are reserved for Icelandic citizens, not open for others.

3. Fishing with trawl is completely forbidden within territorial waters, even for Icelandic citizens. Against the Danish-seine fishery there is conditional prohibition (for Icelandic citizens).

4. According to the present Icelandic legislation, there are no other special regulations affecting the different fisheries¹.

¹ For mesh-regulations and size-limits see Paper 26.

MESH REGULATIONS OF DANISH SEINE AND SIZE LIMITS FOR FISH IN ICELAND

COMPILED BY

ARNI FRIDRIKSSON

After the International Conference on Mesh Regulations and Size Limits for Fish, held in London March 17th—23rd 1937, the Icelandic Minister of Agriculture and Fisheries issued a regulation, which runs as follows:

Regulation on Construction of and Size of Meshes in Danish Seines allowed on the Territory

Article 1. The Danish Seine (Plaice Seine included), which is admitted for use on the territory, shall be a seine towed over the seabottom by means of ropes to an anchored vessel. The seine consists of a short belly and two relatively long wings. The top rope is furnished with large cork-floats, in order to keep the mouth open, and the foot rope is provided with pieces of lead. A wooden cylinder is fastened to each foreend of the wings. On these cylinders the tows are fastened by means of short crow-foot. There are no boards or any other device for expansion of the wings. There are neither any devices on the ropes, such as wisps of straw, which might add to the expansion of the net.

Article 2. In Danish Seines used on the territory, either for catch of roundfish or flatfish, the minimum size of mesh anywhere in the net shall be such that when the mesh is stretched diagonally lengthwise of the net, a flat gauge 120 millimetres broad and 2 millimetres thick shall pass through it easily when the net is wet. Icelandic fishing vessels are also prohibited to carry on board any net with smaller meshes than described above.

Article 3. It is prohibited to land or retain on board fish under the sizes indicated below, as measured from the tip of the snout to the terminal end of the tailfin:

Plaice	27 cm.	Megrim	26 cm.
Lemon Sole	25 »	Haddock	26 »
Witch	26 »		

Fish under these sizes shall immediately be removed to the sea after capture. It is also prohibited to buy or sell fish of smaller sizes from Danish Seine catches.

Article 4. Penalties for infractions of this regulation shall be fixed according to law from April 26th 1937 on amendment of law No. 55 from May 7th 1928 on restrictions of seine-netting on the territory.

Article 5. This regulation is made in conformity to law from April 26th 1937 to come into force at once except for the provision on mesh sizes in the 2nd Article, which shall not come into force until January 1st 1938.

Later in the year 1937 the Icelandic government ratified the London Convention from 1937, by law that came into force Dec. 21st 1937. Yet the regulation continued to be in force, as it still is, except for an amendment provided by law No. 19, May 28th 1941, when the minimum sizes for lemon sole and witch were increased from 25 and 26 centimetres respectively to 27 cm. At the same time the dab was added to the list and protected by the same minimum size (27 cm).

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